QC
770
U56
v.3
no.1

UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

Vol. 3 No. 1
July 15, 1949

Issuing of these Abstracts does not constitute authority for declassification of any documents

Technical Information Branch, Oak Ridge, Tennessee
AEC, Oak Ridge, Tenn., 7-15-49 1800-A12331

Printed in U.S.A.
PRICE 25 CENTS

UNIVERSITY OF MICHIGAN LIBRARIES

NUCLEAR SCIENCE ABSTRACTS

Vol. 3 No. 1

Chemistry Library
QC
770
.U56
v.3
no.1

Contents for July 15, 1949

Category	Abstract No.	Page
General		1
Atomic Power and Nuclear Reactors	1	
Biology and Medicine		1
Biological Effects of Radiation	2	
Biology, General	15	
Health Protection	25	
Radiography	27	
Radiotherapy	29	
Tracer Applications - Biology	58	
Chemistry		20
Chemistry, Analytical	75	
Chemistry, General	90	
Radiation Chemistry	97	
Spectrography	100	
Tracer Applications - Chemistry	102	
Transuranic Elements	104	
Uranium and Uranium Compounds	106	
Mineralogy, Metallurgy and Ceramics		26
Metals and Metallurgy	110	
Minerals and Mineralogy	119	
Physics		28
Absorption and Scattering of Radiation	120	
Cosmic Radiation and Mesons	121	
Instruments	131	
Isotopes	135	
Isotopes Separation	139	
Mass Spectrography	140	
Neutrons	142	
Nuclear Properties	150	
Nuclear Transformation	154	
Physics, General	157	
Physics, Nuclear - Methods of Measuring	160	
Physics, Theoretical	165	
Radioactivity	172	

Location List

Atomic Energy Commission Declassified Documents

Document No.	Abstract No.	Page
AECD-2590	157	37
AECD-2591	15	4
AECD-2592	16	6
AECD-2593	17	7
AECD-2594	142	34
AECD-2595	2	1
AECD-2596	3	1
AECD-2597	160	38
AECD-2598	106	26
AECD-2599	75	20
AECD-2600	76	20
AECD-2601	77	20
AECD-2602	78	20
AECD-2603	79	20
AECD-2604	80	21
AECD-2605	18	7
AECD-2606	107	26
AECD-2607	81	21
AECD-2608	104	25
AECD-2609	105	25
AECD-2610	131	31
AECD-2611	172	41
AECD-2612	82	21
AECD-2613	19	8
AECD-2614	4	1
AECD-2615	143	34
AECD-2616	90	22
AECD-2617	83	21
AECD-2618	84	21

Atomic Energy Commission Unclassified Documents

AECU-220 (WU-2)	135	32
AECU-221 (NYU-1)	25	9
AECU-222 (UCRL-266)*	91	22
AECU-223 (UCRL-331)	154	37
AECU-224 (K-392)	85	21
AECU-225 (UR-69)	20	8
AECU-226 (BNL-C-8)	92	23
AECU-227 (Y-369)	173	41
AECU-228 (UCRL-318)	86	22
AECU-229 (CH-3890)	5	1
AECU-230 (MLM-298)	132	31
AECU-231 (ORNL-316)	6	2
AECU-232 (ORNL-326)	93	23

Chem.
H.W. Willard
gift

GENERAL

1 Nuclear reactors for power supply. G. C. J. Dalton. Engineering 167, 391-2(1949) Apr. 29.

The development of the first nuclear reactors is described and the major practical problems arising are noted. The economical value of nuclear power is questioned; however, one advantage of this type of power cited is the small weight of fuel required by a nuclear reactor which suggests its possible usefulness in regions where steam and water power are not available.

BIOLOGY AND MEDICINE

2 Fast neutron irradiation procedure. Ellice McDonald. AECD-2595, nd. Decl. May 23, 1949. 19p. For publication in NNES.

Procedures for the uniform exposing of animals to fast neutrons produced by deuteron bombardment of beryllium in a cyclotron are given. The method used for measuring the intensity of neutron radiation is outlined. The preparation of the animals for experimental use is detailed.

3 Histological effects on the embryo following x-radiation. Roberts Rugh. AECD-2596, nd. Decl. Apr. 4, 1949. Proposed for publication in J. Morphol.

Larvae of Amblystoma punctatum (a salamander) measuring 2.2 cm in total length were given a single dose of 15,000 r x-rays for the purpose of studying the resultant histo- and cytological changes after a period of 1 week, when they were killed. Mitosis was abruptly inhibited in all cells which had not started the process. Those cells which were in mitosis at the time of irradiation were either able to complete the process or the nuclei and chromatin were so severely damaged that the typical intermitotic "resting cell" stage could not be achieved. The tissues most resistant to x-ray damage in the larva were cartilage and muscle, probably because they were the farther developed. There was no evidence of damage to the intercellular matrix of the cartilage or to the myoplasm or myofibrillae of the muscle. The tissue most sensitive to x-ray damage in the larva was that of the central nervous system and the related sense organs. Neuroblasts were sloughed off into the brain cavity and neurocoel, cells and nuclei were in all stages of degeneration, and there was no evidence of growth. This tissue is the most actively differentiating tissue at the time of irradiation. The larval or embryonic tissues are variously sensitive to x-ray damage in a manner quite different from the adult tissues. Discussion is included which points to the possibility that severe damage is impinged upon the so-called resting cell, as compared with the more obvious mitotic phases, since there was complete inhibition of mitoses in all non-mitotic cells.

4 Experimental radiation pathology. Thomas B. Barnett. AECD-2614, nd. Decl. May 31, 1949. 12p.

This discussion is limited to a brief descriptive review of the characteristic alterations which have been observed in certain radiosensitive mammalian organs following irradiation. For purposes of illustration, the summaries of the results of experiments carried out in the laboratories are included. Descriptions of these specific findings are supplemented with a review of some of the pertinent findings of other investigators.

5 The effect of total-body x radiation on a pre-existing induced anemia in rabbits. III. Histopathological studies. Matthew H. Black, Leon O. Jacobson, Edna K. Marks, and Evelyn Gaston. AECU-229, June 1946. 45p.

Exposure of normal rabbits to 800 r total-body x-radiation produces an intense destruction and atrophy of lymphatic and myeloid tissue that is manifested in the peripheral blood by a leucopenia, thrombocytopenia, and anemia. In rabbits with an anemia, reticulocytosis, and with a hyperplasia and left shift in erythrocytopoiesis in the spleen and bone marrow, exposure to 800 r total-body x-radiation results in: (a) the usual destructive and atrophic sequelae in the hematopoietic tissues but with significantly less destruction of erythroblasts and significantly less inhibition of mitotic proliferation of erythroblasts so that comparatively large numbers of immature erythroblasts survive in the marrow

BIOLOGY AND MEDICINE (continued)

and spleen; (b) a continued reticulocytosis which is derived from these islands of viable erythroblasts during what should, in normal animals, be a much more atrophic period; and (c) a marked reticulocytosis in the regenerative period which is in part explained by a quicker regeneration of normal erythrocytopoiesis in the spleen. These results challange the commonly held belief that cells that are more immature and rapidly dividing are more susceptible to irradiation.

6 The effect of total body x-radiation on the activity of several enzymatic systems of rat spleen. C. E. Carter. AECU-231, Apr. 26, 1949. 24p.

Because of the sensitivity of mammalian hematopoietic tissue to damage from ionizing radiation, rat spleen has been assayed for enzymatic activity catalyzing the degradation of benzoyl-L-argininea-mide, glycyl-L-leucine, leucylglycylglycine, and glycyldehydroalanine, substrates for intracellular proteolytic enzymes; the phosphate activated desamidation of glutamine; and the degradation of ribonucleic and desoxyribonucleic acid in spleens from normal animals and from animals exposed to x-radiation. The late effects of whole body x-radiation on the several enzyme systems of rat spleen are described. Of the enzymes studied, ribonuclease shows the most striking alteration of activity following radiation, depressions of activity being found 24 hours following exposure to doses as low as 100 r. In rats exposed to 500 r, ribonuclease activity in spleen is severely depressed and no evidence of recovery was found in periods up to 12 days following radiation.

7 Action of the semi-carbazone of adenochrome on petechiae caused by x-radiation. A. Herve and J. Lecomte. Arch. intern. pharmaco. dynamie 79, 109-12(1949) Apr. 15 (in French).

Experiments are described which indicate that the administration of the semi-carbazone of adenochrome (adrenoxyl-1-) greatly reduces the cutaneous purpura produced by x-radiation in mice of the A.K.A. strain although the length of survival-time is not significantly augmented. One hundred and forty mice of the pure strains A.K.A., C and C_{57} received daily, 400 r x-ray doses for four consecutive days. Half of the experimental animals had previously received 200 μg. of the adrenoxyl by intraperitoneal injection in a 0.2 cc volume, whereas the other half, serving as controls, were similarly injected with 0.2 cc of physiological serum. The skins of the animals, which were sacrificed six days after the irradiation was begun, were detached. Examination of the internal surfaces of the skins indicated that while the control animals showed petechiae (purpuric eruptions) and hemorrhages, particularly in the sacral regions, the adrenoxyl-injected group did not show any capillary hemorrhage and few purpuric eruptions. It is noted that preliminary experiments have shown that x-radiation does not always produce petechiae in mice and that C_{57} mice sometimes die from irradiation before they show signs of petechiae.

8 Effect of neutron radiation on the human testes: a case report. John N. Robinson and Earl T. Engle. J. Urol. 61, 781-4(1949) Apr.

A case showing the radiation injury effects from a neutron bombardment involving the human testes is presented. The accurate radiation dosage is not known, but the exposure time to the bombardment was only a fraction of a second. Three weeks after injury there was no evidence of spermatozoa, and loss of facial and head hair had occurred. The results of two bilateral testes biopsies are summarized. The first biopsy revealed normal tissue with no tubular fibrosis, but few spermatogonia were present. The second biopsy showed some residual damage to one testis, and marked improvement in the amounts and stages of spermatogenesis in the other testis. The spermatogenesis had begun to return between the 12th and 15th month following injury.

BIOLOGY AND MEDICINE (continued)

9 Effect of radioactive phosphorus (P^{32}) in the culture medium on growth and viability of phomopsis citri and diplodia natalensis. Erston V. Miller and Jerome J. Wolken. Science 109, 492-3(1949) May 13.

The effects of P^{32} on the physiology of Phomopsis citri and Diplodia natalensis, the fungi causing stem-end decay in oranges, are described, together with the experiments which were performed. Potato dextrose agar was mixed in a 20 to 1 ratio with a solution containing 0.156 — 0.245 μc/ml of P^{32}. The fungi were grown on the treated culture medium and then used to innoculate naval and Valencia oranges. Results showed that the activity of the fungi was seriously impaired by the radioactive phosphorus treatment.

10 Genetic recombinations leading to production of active bacteriophage from ultraviolet inactivated bacteriophage particles. S. E. Luria and R. Dulbecco. Genetics 34, 93-125 (1949) Mar.

Experiments determining the amount of adsorption by bacteria of bacteriophages activated or inactivated under several conditions are described. The genetic mechanisms of bacteriophages were investigated after irradiation by x-rays and ultraviolet rays, and inactivation with nitrogen-mustards. A mechanism of phage reactivation by interaction among inactive particles in the course of intracellular growth is presented. Coli-bacteriophages T_2-T_7 were used. Radiation times and effects are included in 7 tables. Conclusions are that coli-bacteriophages T_2, T_4, T_5 and T_6 inactivated by ultraviolet light are still adsorbed by sensitive bacteria. The assumption is made that inactivation is due to lethal mutations in a number of genetic "units" of the phage particle, and that production of active phage from inactive is due to recombination of non-lethal units to form active particles. Calculated values on the basis of this assumption agree with data. 7 references.

11 Improvement in streptomycin-producing strains of streptomyces griseus by ultraviolet and x-ray energy. George M. Savage. J. Bact. 57, 429-41(1949) Apr.

Approximately 3700 isolates of Streptomyces griseus RRC No. 3496 were irradiated by both ultraviolet and x-rays to produce high-streptomycin-yielding strains. Two methods of x-irradiation were employed: (1) irradiations of suspensions in sterile cellulose bags using a Picker Company x-ray unit with a copper or molybdenum target, and (2) irradiations of suspensions in evaporating dishes ensuring entire surface exposure, with a new high-intensity beryllium x-ray tube utilizing a tungsten target. X-rays were found to be much more mutagenic than ultraviolet rays, and among x-rays, the harder rays of 0.710 A and 0.210 A wavelengths were found to be the most efficient mutagens. The mutation rate increased with the killing rates up to 99.9% killing. By using doses up to 1,000,000 r, mutation rates as high as 50% were observed on morphological characteristics, and as high as 40% on the single physiological characteristic of streptomycin production.

The superior strains selected proved to be extremely unstable and quickly reverted to the parent type, insofar as streptomycin production was concerned. Less than 0.1%, 3 out of 3700 strains studied, proved to be superior in a stable fashion. The results indicate that strain superiority is very dependent upon the medium being fermented. Since many strains cannot demonstrate their superiority when tested in larger fermenters, or in media differing only slightly in composition from that used for screening, large numbers of superior strains must be found for each strain that is ultimately utilized.

12 A new theory of mutation and the origin of cancer. Leonell C. Strong. Yale J. Biol. and Med. 21, 293-9 (1949) Mar.

A new theory of the origin and relation of cancer to mutation in a series of species is presented. The use of x-rays as a procedure for producing cancer and mutation is noted. Mention is made of the possibility of involvement of radioactive chemicals and cosmic rays in spontaneous mutations associated with cancer.

BIOLOGY AND MEDICINE (continued)

13 The production of chromosome interchanges in drosophila virilis. William K. Baker. Genetics 34, 167-92(1949) Mar.

The results of present investigations involving x-radiations of the sperm of Drosophila virilis males are described. Only a particular type of chromosome rearrangement is studied, namely, exchanges between different chromosomes. The frequency with which these interchanges occur at different dosage levels provides some insight into the manner in which the breaks are formed. The relative sensitivity of the different chromosomes to breakage and the relative frequency that certain numbers of chromosomes are involved in the recovered interchanges are revealed. Some insight is gained into the course of events taking place during the joining of broken chromosome ends. Temperature variants are used. Detailed data on the type of irradiation apparatus, the technique and methods applied are given. Dosages of 1000, 2000, 3000, 4000 r are given and 2 tables list the relation of interchange production to dosage and temperature variants. Conclusions are that the percentages of sperm with interchanges are not proportional to dosages. The relationship varies still further at different temperatures. Restitution of broken chromosome ends is no more likely to occur than recombination. The union process is therefore assumed to be at random. 33 references. 5 figures. 5 tables.

14 Studies on x-ray mutations in the white and forked loci of drosophila melanogaster. I. A statistical analysis of mutation frequencies. G. Bonnier and K. G. Lüning. Hereditas 35, 163-89(1949).

X-ray experiments on a wild variety of Drosophila melanogaster, involving reasonably low doses and observations on a few of the most easily discernible loci, are described. The method used permitted estimates of variations in group doses and statistical analysis of the experimental results. Doses of 727 r, 1454 r, 2181 r, and 2908 r were administered to different groups by means of Sievert's ionization chamber. The 1,216,698 female progeny of the irradiated males formed the basis of the statistical investigation. Results of control experiments indicated a non-linear relationship between mutations and dose. No final conclusions are drawn in this paper. 16 references. 9 tables.

15 Biological studies with polonium, plutonium, and radium. Part I. Distribution and excretion of polonium. Edited by Robert M. Fink. AECD-2591, Jan. 1, 1947. Decl. May 18, 1949. 214p. For publication in NNES.

Chapter I. General Methods Employed in Polonium Distribution and Excretion Experiments. Polonium stock solutions were kept in 0.308 N HCl, then neutralized and made isotonic shortly before injection. Under the conditions the loss of polonium through adsorption on glass apparatus or plating out on hypodermic needles was probably negligible except during the autoclaving of neutral solutions for human studies. In rat experiments, a tuberculin syringe with a No. 27 syringe needle was used for intravenous injections into the caudal vein and for subcutaneous injections into the leg, and a syringe with an attached rubber catheter used for intra-gastric administration. After injection the rats were kept in all glass metabolism cages arranged for separate collection of urine and feces and fed a diet consisting of equal volumes of powdered dog chow and "Celluflour" to keep the feces hard enough to avoid sticking in the cage. At the end of the experimental period, the rats were sacrificed by bleeding and samples taken from most of the tissues. The tissues and excreta were then digested by a perchloric acid-nitric acid mixture and the digests neutralized and made up to 0.5N H^+ with HCl. The polonium was deposited on the center portion of one side of silver foils by electrochemical displacement. Measurement of the cavity was generally done with an electrometer, but low activities were measured with an alpha counter. Procedures employed to minimize contamination of samples included the classification of various laboratories and of pieces of glassware according to the strength of samples to be permitted in them and the identification of individual pieces of glassware for the purpose of recording their history in the laboratory. Decontamination of glassware included an overnight soaking in 3N HCl plus an acid stable wetting agent, and when possible a thorough scouring with Bon Ami.

Chapter II. Polonium Distribution and Excretion Experiments with Animals. In the eleven experiments in which complete analyses of injection solutions, excreta, and tissues were carried out, the amount of polonium recovered from tissues and excreta, when adjusted for loss by radioactive decay,

BIOLOGY AND MEDICINE (continued)

averaged 92% of the amount found in the "dummy injection" solutions. This fact, in addition to the finding of approximately the same total recovery values in short or long-term experiments and the failure of attempts to recover significant amounts of polonium in expired air, indicate that the lungs and skin are not important routes of elimination of polonium. Following intravenous administration of freshly neutralized polonium chloride in rats, the average rate of urinary excretion was maximal, 0.19% of the body content, in the first day after injection, fell to about 0.08% of body content per day for the next two weeks, then rose sharply and remained in the neighborhood of 1.13% per day from about 30 to 200 days after injection, at which point the daily polonium output became too low for accurate measurement by the routine procedure. The daily fecal excretion fell from a maximum of about 60 times the urinary excretion on the third day to 30, 6, 5, and 4 times the urinary excretion at 10, 50, 100, and 200 days after injection, respectively. Due to the elimination of polonium in urine and feces and by radioactive decay there remained in the body at 10, 100, and 300 days after injection only about 70, 17, and 1 microcuries per 100 microcuries originally injected. Among the tissues of intravenously injected rats, spleen, kidney, and lymph nodes generally showed the highest concentrations of polonium, with bone marrow, blood cells, adrenals, pancreas, and thyroid generally only slightly lower. The relative concentration in testes and brain rose at the longer periods after injection while that of plasma and liver decreased. A single experiment with a female rat showed the uterus as one of the most active tissues while the ovary was about average.

Oral administration of freshly neutralized polonium chloride to rats resulted in tissue concentrations 10 days after ingestion equivalent to those expected from intravenous administration of about 2% of the oral dose. The red blood cells showed the highest concentration of polonium, probably accounting for more than one-third of the total body polonium content. The data on urinary excretion indicated that polonium absorbed through the intestine was excreted by the kidney for a few days as much as 100 times more efficiently than in the case of intravenously administered polonium but the possibility of direct contamination of the urine in the oral experiments could not be completely ruled out. After elimination of the unabsorbed polonium, fecal excretion was at a level commensurate with the tissue content and data on intravenous experiments. About 45% of a dose of freshly neutralized polonium chloride injected subcutaneously into the foreleg of rats was absorbed within 24 hours, but the remainder was absorbed very slowly, 40% of the dose remaining at the injection site 10 days after injection. At least 1% of the absorbed polonium was excreted in the urine in the first day, indicating a kidney efficiency about five times greater than in the intravenous experiment, but after the first day the urinary excretion of the absorbed material was very similar to that expected from intravenous experiments. The fecal excretion of the absorbed polonium was somewhat lower than the average for intravenous experiments, but in the same general range. Tissue distribution was very similar to that found for intravenously administered polonium. The long retention of a high concentration of polonium at the subcutaneous injection site might eventually lead to local damage from the intensive radiation.

Experiments in which rats were caused to inhale polonium evaporated from an electrically heated nickel foil indicated that: (1) a large proportion (probably over 30% and perhaps in some cases approaching 100%) of the vaporized polonium inhaled by a rat is retained in the lungs, (2) most of the polonium captured by the lungs is absorbed into the blood stream, giving essentially the effect of an intravenous injection, and (3) sufficient polonium may be retained in the lungs for a prolonged period to produce direct effects in that organ. Neutralized polonium chloride placed on the skin of a mouse's foot was apparently absorbed at a rate in the order of 0.005% per day. Very meager data indicated that polonium in ligroin solution might be absorbed somewhat more readily. In a single intravenous experiment with a rabbit the total urinary excretion of 35% of the dose in 10 days, as compared with the rat's total of 0.91%. The fecal excretion of rabbit and rat was similar. The tissue distribution was in general similar to that in the rat, but the rabbit kidney had a polonium concentration four times higher than that of any other organ.

Chapter III. Studies of Polonium Metabolism in Human Subjects. The rates of excretion of polonium by four human subjects, injected intravenously with 0.17 to 0.3 microcurie of polonium per kilogram of body weight, were of the same order of magnitude as those observed in experiments with rats. During the first week after injection their average daily urine content was 0.1% of the theoretical dose. In two

BIOLOGY AND MEDICINE (continued)

cases, followed for longer periods, this daily average fell to about 0.06% during the second week, and to 0.03% at 40 days. On a single observation the urine collected on the 70th day after injection contained 0.02% of the theoretical dose. Polonium was eliminated in the feces at a level 10 to 20 times higher than in urine. Fecal analyses on two of the subjects showed an average daily output of 1.5% of the theoretical dose during the first week. One subject, whose early fecal contents had been the lower of these two, continued to excrete amounts fluctuating around 0.8% of the theoretical dose per day for another two weeks, then dropped to 0.6% at 40 days and 0.25% at 70 days. Evidence of rapid disappearance of injected polonium from the blood stream was found by early sampling in two of the cases. Within the first half hour the average total circulating polonium was less than 5% of the theoretical dose. The whole blood concentration at the end of 24 hours in the four cases averaged 2% of the theoretical dose per liter. They each showed a moderate rise, more marked in cells than in plasma, between 3 and 5 days after injection, the average at 3 days being 2.7% of the theoretical dose per liter of blood. The values then fell gradually to about one-tenth of this level at 70 days. The concentration in cells was generally two or three times greater than in plasma, and somewhat greater in white blood cells than in red. The uptake by cells was found to be more rapid in the animal body than in vitro experiments at room temperature.

Following ingestion of polonium, in the one case studied, traces of the material appeared quite soon in the blood and urine, but the total absorption was probably less than 10% of the theoretical dose. The first blood sample, taken one hour after administration, contained 0.06% of the theoretical dose per liter. By 48 hours the whole blood concentration was 0.5% per liter, then very gradually declined to a barely detectable amount, less than 0.01% of the theoretical dose per liter, 225 days later. Plasma concentration rose more rapidly in the early period, but after the first week plasma and cell concentrations were similar. By the end of the first $2\frac{1}{2}$ hours, the urine contained 2×10^{-4}% of the theoretical dose, but the most rapid early excretion rate, 0.006% per liter, occurred during the latter two-thirds of the first day. Daily urinary excretions were of 5 to 7×10^{-3}% of the theoretical dose for 30 days after ingestion, then gradually fell to 2×10^{-4}% at 230 days. Fecal elimination amounted to 77% of the theoretical dose by the end of 3 days, averaged 0.26% of the theoretical dose per day between 10 and 30 days, and finally fell to 3×10^{-3}% at 230 days. By this time probably less than 0.6 microcurie remained in the body, giving 10^{-4} microcurie per day in the feces and 10^{-5} microcurie per day in urine. A brief experiment to test absorption of polonium through the human skin indicated that it was absorbed at a rate of not exceeding 2% of the dose per day.

16 Biological studies with polonium, plutonium, and radium. Part II. distribution and excretion of radium. Edited by Robert M. Fink. AECD-2592, Jan. 1, 1947. Decl. May 18, 1949. 84p. For publication in NNES.

Historical Background. A survey of the literature concerning radium metabolism is given. In a review of elimination and retention studies it is indicated that the immediate rate of elimination of radium, which in all cases is relatively fast, depends upon the route of intake. If it is ingested, elimination is very rapid during the first few days, leaving 25 to 35% of the ingested amount in the body after 5 days. Following intravenous administration the initial rate of elimination is considerably slower than after ingestion with 55 to 65% of the dose reported remaining in the body 4 or 5 days after injection. Elimination relatively soon is indicated after inhalation of radium in a single case. In contrast to the early excretion picture the later elimination of radium depends not so much upon the route of intake as upon the depth and manner of fixation in the skeleton. The elimination rate in long standing chronic radium poisoning has been shown to be in the order of 0.005% of the body content per day. The permanent retention of radium in human cases has been found to vary between 0.1 and 10% of the intake with an average at about 2%. In a review of distribution studies it is shown that radium in the blood is thrown out of the circulation system too quickly to be accounted for by the immediate excretion. It must, therefore, go into tissues rapidly. Deposition in various organs and skeleton formations is discussed. 41 references.

Chapter II. General Methods Employed in Radium Distribution and Excretion Experiments. Administration (injection, oral, and intravenous), collection and digestion of samples, sacrifice and

BIOLOGY AND MEDICINE (continued)

dissection, contamination control, and measurements are discussed.

Chapter III. Radium Distribution and Excretion Studies with Rats. The eight experiments in this series were designed to study the metabolism of radium in the white laboratory rat. The intravenous route of administration was chosen because it offered the only quantitative way of knowing how much is in the body as a whole and actually available for excretion or deposition in tissues at any time. The findings from this type of experiment were useful in setting a tolerance level for total absorption of radium at an amount such that the long term retention would not be greater than 0.1 microcurie. They also yield, through urinary excretion data particularly, another criterion for assaying that absorbed amount or the extent to which the body as a whole is endangered. The measurements of breath radon and external gamma radiation are valuable tools for detecting total radium present, but they may not always indicate what proportion of that radium has actually been assimilated. Although the number of animals was small, the results in the group of intravenous experiments were consistent. Two oral experiments of the single dose type were carried out in order to have a more quantitative approach than could be found in the literature to the problem of how ingested radium may be handled by the rat.

17 Biological studies with polonium, plutonium, and radium. Part III, Chapter 1. Toxicity of polonium, plutonium, and radium in rats. Edited by Robert M. Fink. AECD-2593, Jan. 1, 1947. Decl. May 18, 1949. 132p. For publication in NNES.

Pilot studies on polonium, plutonium, and radium to determine the 20-day LD_{50} were made. Polonium dosages ranged from 50 to 170 microcuries per kilogram, plutonium dosages ranged from 18.5 to 185 microcuries per kilogram, and radium dosages ranged from 17 to 8000 microcuries per kilogram. In general, there were two or three animals at each dosage level. The 20-day LD_{50} dosage values in terms of microcuries per kilogram for polonium, plutonium, and purified radium (polonium at approximately 0.07% of equilibrium value) were found to be approximately 50, 130, and 4000 microcuries per kilogram, respectively. The microcurie toxicities relative to purified radium as defined by the ratio of the 20-day LD_{50}'s were approximately 93 and 32 for polonium, and plutonium, respectively. A radium preparation estimated to contain about 2 microcuries of polonium per 1000 microcuries of radium appeared to be about two to four times as toxic as the above purified radium in the period of 40 to 100 days after injection. The weights seemed to be the best clinical criterion of the condition of the rat. In general, as the dosages increased the rate of weight loss increased.

Pathology studies were made on some of the animals at death. Polonium produced changes in the hematopoietic system at all dosage levels used. These changes were marked atrophy of lymphoid elements in the spleen and lymph nodes and marked depression of cellular elements in the marrow. Visceral engorgement was a constant finding. Liver changes were unimpressive. The changes in the 50 microcuries per kilogram range suggest a lesser degree of toxicity than higher levels. The changes with 140 to 170 microcuries per kilogram were not quantitatively different. Visceral hyperemia was inconsistent with x-radiation effects. Radium caused changes in the hematopoietic system, liver, kidney, bowel, bone, testes, aorta, and coronary arteries. The changes in the hematopoietic system bone, testes, and bowel were compatible with x-radiation effects. Liver, renal, and vascular effects were unlike changes produced by x-radiation. Plutonium produced damage to the hematopoietic system, bone liver, testis, and kidney similar to x-radiation. Testes may be less sensitive in comparison with other tissues than it is in high voltage x-radiation experiments. 47 references.

18 Biological studies with polonium, plutonium, and radium. Part III, Chapter 2. Toxicity of polonium, plutonium, and radium in rats. Edited by Robert M. Fink. AECD-2605, Jan. 1, 1947, Decl. May 18, 1949. 172p. For publication in NNES.

Comparative lethal dosage studies of radium, plutonium, and polonium in rats were made to determine the relative toxicities of plutonium, polonium, and radium. Clinical observations, gross and microscopic pathological studies, and hematological studies were made. At death the rats were analyzed for total polonium and radium remaining in their bodies. The retention of plutonium was not detemrined.

BIOLOGY AND MEDICINE (continued)

19 Metabolic studies on protein depleted patients receiving a large part of the nitrogen intake from human serum albumin administered intravenously. Christine Waterhouse, Samuel H. Bassett, and Kathryn Y. Cusson. AECD-2613, Aug. 2, 1948. Decl. May 24, 1949. 63p. Proposed for publication in J. Clin. Invest.

Each of four subjects received a daily dose of 60 grams of concentrated sodium free albumin for ten or more days. Balances of nitrogen, calcium, phosphorus, and potassium were made during control, albumin, and post-albumin periods. Concommitant observations of serum protein fractions, plasma volume, and renal function were made. The individual variations in response are noted, namely: (1) the development of an intense proteinuria in a patient convalescent from rheumatic fever and without evidence of impaired renal function, (2) the retention of water with peripheral edema, hydrothorax, and pericardial effusion and poor utilization of the injected protein in a woman with probable generalized vascular disease, (3) the excellent utilization, but eventual development of signs of cardiorespiratory embarrassment in a young woman in fair health except for moderate undernutrition, and (4) the modification of the response in a normal young male by other dietary factors. The mechanisms of these reactions are discussed. It is felt that proteinuria will develop eventually in any patient when saturation with albumin has occurred and that this is probably not due to renal damage, but represents a physiological response when the maximum reabsorptive capacity of the renal tubules for protein is exceeded. 32 references.

20 The relationship of the cell surface to metabolism. IV. The role of cell surface phosphatases of yeast. Aser Rothstein. AECU-225, Apr. 6, 1949. 25p.

Previous studies have shown that a number of phosphatases are located on the cell surface of yeast. The present paper is concerned with the role of these enzymes in the overall economy of the cell. By using molybdate or tungstate to inhibit the surface phosphatases, it was possible to show that these enzymes play no direct role in carbohydrate metabolism or in phosphate transport into the cell. However, experiments with phosphorylated sugars indicate that the cell surface phosphatases are able to split organic phosphates which the cell cannot utilize directly, into non-phosphorylated organic residues which the cells can utilize. The surface phosphatases thus play an indirect role in metabolism by enabling the cells to utilize phosphorylated compounds.

21 American Association of Anatomists, sixty-second annual session. Anat. Record 103, 417-595(1949) Mar.

Included in the papers read at the 62nd Annual Session of the American Association of Anatomists at Temple University, Philadelphia, Pa., April 13, 14, and 15, 1949, are the following:

Deposition of radioactive strontium and the rare earth promethium in the skeletal tissues of the rat. C. W. Asling, D. A. Heller, D. H. Copp, and J. G. Hamilton.

Detection of the entry of radiophosphate in bones with the help of a new technique, the "inverted autograph." Leonard F. Belanger.

Deposition of C^{14} in the metaphysis of long bones of young rats. William Bloom.

The effect of x-ray irradiation upon the lumbo-sacral region of the axolotl (siredon mexicanum). V. V. Brunst.

Effects of P^{32} on regenerating amphibian tissues. J. N. Dent.

Steady state of the iodine in the thyroid gland of the male rat. J. Dougherty.

The use of radioactive phosphorus in studies of fetal circulation. Newton B. Everett and Robert J. Johnson.

The development of roentgenographic methods to determine depth of penetration of liquid jets into living human subjects. Frank H. J. Figge.

The localization of physiological amounts of thyroxine labeled with radioiodine in the tissues of the rat. J. Gross.

Radio-autographic reactions in tissues other than bones and teeth after injection of radio-phosphorus. C. E. Stevens.

BIOLOGY AND MEDICINE (continued)

The following papers were read by title:

A radioautographic study of the localization of radioactive europium in certain soft tissues of the rat. C. D. Van Cleave.

Studies on the effects of x-radiation on morphogenesis of amblystoma punctatum. S. W. Hanford.

The effect of intraperitoneally injected radium chloride upon the peripheral blood of albino male rats. Paul G. Roofe and Frank E. Hoecker.

Roentgenology as a means of instruction in anatomy in North American medical schools. Wayne A. Simril, A. Jack Stacy, and Sydney F. Thomas.

Detection of radio-elements by various radio-autographic techniques. C. P. Leblond, L. F. Belanger, R. Bogoroch, C. E. Stevens, J. Gross, and G. Wilkinson.

Abstracts of the papers are presented.

22 Coagulation of oxalated plasma without calcium following neutralization of heparin by toluidine blue. Jaromir Myslivecek. Nature 163, 605-6(1949) Apr. 16. (Letter to the editor).

The hypothesis that the interaction between the heparin complex and thromboplastin of plasma is the cause of the fluidity of blood in the vessels and that calcium, in some way, either with a tissue extract or otherwise, neutralizes the heparin complex was tested by the experiment described. Toluidine blue was used to oppose heparin's effect, and thus to facilitate coagulation of the decalcified plasma used. Results show that toluidine blue has the aforementioned effect, since the preformed plasma-thromboplastin is active enough to produce coagulation of the blood when the heparin is removed.

24 Poisoning in children. Newer methods of treatment. W. W. Lueck, Lancet 69, 155-59 (1949) May.

Among the newer methods of treatment of poisoning in children, British Anti-Lewisite (BAL) is mentioned in connection with the alleviation of effects of heavy metal poisoning. The BAL sulfhydryl groups compete successfully with the body protein and enzymes, thereby detoxifying the metal ions. A recent review of much of the literature on BAL was brought out by Randall and Seeler [New England J. Med. 239, 1004 and 1040(1948)] . Some toxic effects reported by various experimenters are anorexia, restlessness, vomiting, pain at the injection site, salivation, hypertension, fever, tachycardia, convulsions, "Leukotoxic effect," and reducing substance in the urine. Tye and Siegel [J. Am. Med. Assoc. 134, 1477(1947)] report the relief of toxic symptoms in adults by the use of 0.6 cc of a 1:1000 solution of epinephrine hydrochloride given intramuscularly. Prevention of the toxic symptoms can be brought about by the administration of 25 to 50 mg of ephedrine sulfate a half hour before administration of BAL. A discussion of the treatment of lye, kerosene, DDT, and other types of poisoning is presented. The importance of the proper performance of gastric lavage is emphasized.

25 Effect of beryllium compounds on sewage effluents and streams. M. M. Luckens. AECU-221, Jan. 1949. 46p.

This report presents a survey of the literature of beryllium compounds which may be expected in sewage effluents and streams. The probable effect of beryllium compounds on sewage and water courses is discussed in the light of the data in the literature and the findings of this laboratory. Normal compounds of beryllium in aqueous solution do not exist in the region of neutrality. These compounds in solution, therefore, should be treated as acid or alkaline wastes, depending upon the conditions. In view of the commercial value of beryllium oxide, it might be economically feasible to precipitate the hydroxide out of the effluent before discharge into the receiving body of water. This would reduce the health hazard as well as the possibility of detrimental effects on the stream. It was found experimentally that beryllium hydroxide, and possibly beryllate ion, caused an appreciable depression in the dissolved oxygen content of Theriault-Nichols dilution water and sewage dilutions as determined by the azide modification of the Winkler method. The high acidity of beryllium sulfate solutions prevented the determination of dissolved oxygen by standard methods. The determination of the dissolved oxygen of sewage effluents or dilution waters containing beryllium compounds calls for the development of a special method of analysis.

BIOLOGY AND MEDICINE (continued)

26 Laboratory handling of radioisotopes in cancer research. Shields Warren and John Z. Bowers. Am. J. Pub. Health 39, 654-7(1949) May.

The dangers of some common radioisotopes which are used in the laboratory and hospitals for research and therapeutic work are pointed out. The amounts and types of radiation and the precautionary measures necessary for each are discussed. The importance of detecting these radioactive substances at their laboratory instrument level is stressed. Pocket electroscopes, dental film badges, and frequent blood count tests are useful control measures. The role of radioisotopes in therapy is also covered.

27 British Progress in 1948. George A. Jones. Photo. J. 89A, 84-91(1949) Apr.

The progress in the various fields of photography made in Great Britain during 1948 is reviewed. The advances made in radiology, autoradiography, and the recording of the passage of charged particles are among the topics considered. 65 ref.

28 Preparation of radioautographs to show the distribution of phosphorus-32 in plant tissues. R.Scott Russell, F. K. Sanders, and O. N. Bishop. Nature 163, 639-40(1949) Apr. 23 (Letter to the editor).

A method for the detection of P^{32} in plant tissues through the use of radioautographs is described. Complications such as considerable diffusion of phosphorus in the fixatives and the loss of the tracer in the preparation of the histological sections are overcome by the techniques described. The results obtained from the experiments on the stem of the young barley plant show that the concentration of P^{32} occurs especially in the apical meristem, the leaf primordia, the bases of the younger leaf sheaths, and the initial part of the adventitious root.

29 Basal cell epithelioma: some valuable pointers gained in the successful treatment of 300 cases by x-ray radiation. George H. Carr, Sr. Virginia Med. Monthly 75, 420-1 (1948) Aug. (Letter to the Editor).

This review of actual experience in a large number of basal cell epithelioma cases classifies the carcinomas into 7 distinct types and lists therapeutic methods which are in use. X-radiation produced about 98% of the cures effected by the author. The best results are obtained by fractional doses of 40 r-units twice a week, carefully administered through a 4 ma tube at 88 kv peaks. A 2 cm area is irradiated, usually during 8 to 12 periods. The procedure is also effective in cases of senile and other forms of keratosis, cutaneous horns, and other precancerous conditions.

30 The basal metabolism in cancerous patients undergoing radiotherapy. D. Agostini and P. Lorenzini. La Radiologia Medica 34, 415-20(1948). (in Italian).

Basal metabolism rates (B.M.R.) were taken on 26 cancerous patients in the Radium Institute of Bologna, before, during, and after radiation treatment. There was a B.M.R. increase just before treatment, a further increase during treatment, and a continued raised level after treatment. The site of the irradiation had no influence. Doses and the types of rays used were not listed.

31 Carcinoma of the cervix. Hugh F. Hare and C. Franklin Sornberger. Southern Med. J. 42, 365-72(1949) May.

Past and present techniques for the treatment of carcinoma of the cervix with radiations are described. External roentgen therapy at 7000-15000 r is lethal to the carcinomas of the pelvis. Typical cases and individualized applications of the technique are discussed. By a combination of interstitial radium therapy with external roentgen therapy a cancerocidal dose is delivered to most or all of the tumor-bearing areas. The cases are divided into 4 classes on the basis of severity of affliction, and mortality rates on each type are listed. These rates vary from 4.9% to 76.1% depending on the data accumulated and the type of case. Conclusions are that radiation therapy is the only acceptable method of treatment and that future successes in cervical carcinoma therapy will come from modifications of the techniques presented. 19 references.

BIOLOGY AND MEDICINE (continued)

32 Carcinoma of the cervix. Louis J. Levinson, William M. Brams, and B. Levinstone. J. Med. Soc. New Jersey 46, 234-37(1949) May.

The results of a three-year follow-up on 54 cases of carcinoma of the cervix which had been treated with radiotherapy are presented. The usual series of high voltage x-ray treatments is administered over a 24-day period at an average dose of 2000 r as a preliminary procedure to augment the amount of radiation delivered to the parametrium, to clean up the infected cervix, and to facilitate the subsequent insertion of radium. The average radium doses of 6500-7000 mg-hr are administered by a modified Curie technique over a period of 4 days. When the total dosage is administered over a shorter period of time, complications such as local vaginal necrosis and ulceration of the adjacent bowel occur in some cases. The tolerance of the interior of the uterine cavity is phenomenal and doses of 20,000-30,000 r/100 hr can be given safely. The tolerance limit of the vaginal mucosa is 12,000 r. A dose of 6,000 r is lethal to a tumor bearing area, resolving the majority of epidermoid carcinomas. A complication of this treatment is post-radiation burns. The three-year survival rate is 53.3% for the early cases and 21.7% for the late cases.

33 Concerning permanent healing of cancer, lupus, and keloidosis cases with roentgen radiation after the manner of Chaoul. Juraj Körbler. Radiologia Clin. 18, 54-62(1949) Jan. (in German)

A review of the results of treatment of skin carcinoma by short distance roentgen radiation is given in which the various techniques and dosages are noted. Therapy varies within a wide range, usually 5000 r weekly, for the cancer, lupus, and keloidosis. Some of the author's cases are cited. Mortality and recovery rates are given in 2 tables. The beneficial results indicate that short distance x-ray therapy is valuable, since its action in superficial skin cancer is comparable to that of radium therapy. Which of the two procedures is preferable must be determined by the individual case.

34 Concerning the treatment of leukemias with roentgen rays. Alfred Vogt. Deut. med. Wochschr. 74, 42-5(1949) Jan 14 (in German).

Data on the increase in the life span of patients with myeloidal and lymphatic leukemias, through the improvement of radiation techniques from 1905 to 1935, are presented. Cases over this period of years indicate that the life spans for patients with chronic myeloidal leukemias have been increased from an average of 13.7 months in 1905 to 29.3 months in 1935, and for chronic lymphatic leukemias from 17.4 months in 1905 to 22.6 months in 1935. The acute forms of leukemia react unsatisfactorily to ray therapy. Doses range from 300 r a week for myeloidal leukemia to 50-100 r a week, and in some cases 300 r a week, for lymphatic leukemia. Chronic myeloidal leukemia reacts favorably to uniform radiations of the spleen, and chronic lymphatic leukemias to over-all radiations. The available procedures and their indications and contraindications in atypical cases are described.

35 Dosage problems in roentgen therapy. R. Pape. Klin. Medizin. 3, 665-73(1948) (in German).

The present methods of protracted radiation enable the increase in effective dosages from 600 r to 4000-5000 r. Dosages of 10,000-20,000 r can now be given by contact radiations. Minimal doses of 2-20 r have therapeutic value chiefly in cases of furunculosis of the face, mastitis, whitlows, and acute and chronic sinusitis. Treatment-resistant inflammations, lymphomata, osteomyelitis, tonsillitis, and diseases of the thymus are being effectively cured or reduced by means of these low doses.

36 Evaluation of the present treatment of hyperthyroidism. John de J. Pemberton, Samuel F. Haines, and F. Raymond Keating, Jr. J. Intern. Coll. Surgeons 12, 223-8(1949) May-June.

A review of clinical experience at the Mayo Clinic with various types of thyroid therapy is given. Results with goitrogenic compounds, radioiodine, and thyroidectomies are discussed. Radioiodine has provided a means for studying the thyroid function in man and is responsible for a considerable quantity of new information concerning metabolism of iodine, the behavior of thyroid tumors, and the action of

BIOLOGY AND MEDICINE (continued)

antithyroid drugs. Results of the use of radioiodine as a therapeutic agent in the treatment of carcinomas of the thyroid are disappointing. Radioiodine is effective in cases of hyperthyroidism. Radioiodine treatments are limited to older patients for whom thyroidectomy is considered unduly hazardous. Patients of recurrent exopthalmic goiter seem to be best suited for radioiodine therapy.

37 Ewing's sarcoma and reticular bone sarcoma. Clinical and differential diagnosis. E. Uehlinger, Ch. Botsztejn, and H. R. Schinz. Oncologia 1, 194-245(1948) (in German).

The differences between Ewing's sarcoma and reticulo-sarcoma of the bone are presented in 31 cases, together with the x-ray therapy used. Three typical cases of each group are described in detail with their anatomical, radiological, and clinical manifestations. Both Ewing's sarcoma and reticulosarcoma of the bone are sensitive to radiation, Ewing's sarcoma requiring dosages of 4000-10,000 r within a 20 to 50-day period for best results and the reticulo-sarcoma requiring 8000-10,000 r in a 40-day period. The results indicate effective diagnosis of these diseases can be based on the correlation of clinical, radiological, and anatomical findings. The x-ray observations show that Ewing's sarcoma produces osteolysis. The reticulo-sarcoma develops similarly, but with an additional osteosclerotic change. 42 figures, 5 tables, 40 references.

38 Gonadal aspects of the exophthalmos of Graves' disease: clinical successes and failures of roentgen therapy applied through orbital-pituitary portals. Frederick B. Mandeville. Urol. and Cutaneous Rev. 53, 268-301(1949) May.

A review of results of roentgen therapy on three distinct groups of patients suffering the exathalmos of Graves' disease is given with the gonadal aspect stressed. These groups are (1) a children's or pregonadal, (2) an adult or active gonadal, and (3) an elderly or post-gonadal. Radiation doses to the pituitary gland through the temporal regions of the head were 150-200 r per treatment over short periods of time. The case histories of 4 patients receiving this type of therapy are included together with a comprehensive summary of the history of irradiation of the pituitary gland from 1905 to the present. Clinical control of Graves' disease was obtained in some cases for a number of years through this therapy. 35 references.

39 Grenz ray (supersoft roentgen ray) therapy of cutaneous diseases. Seymour L. Hanfling. Arch. Dermatol. and Syphilol. 58, 390-7(1948) Oct.

Grenz ray therapy was compared with roentgen radiation in 76 series on 58 patients with various dermatoses. The patients generally received 100 r roentgen rays at 95 kv weekly and/or 270 r Grenz radiation twice weekly. The technique and specific penetration depths of Grenz radiation are given. The results are listed in 4 tables and indicate that Grenz ray therapy compares favorably with roentgen radiation, Grenz radiation being especially useful in superficial skin disease cases.

40 The irradiation treatment of carcinoma of the breast. F. M. Allchin and C. W. Wilson. Brit. J. Radiology 21, 406-13(1948) Aug.

Two methods of radiation treatment of carcinoma of the breast are described. The first method is pre-operative and is called the pre-determined shape method, the uniform field of radiation usually being in the shape of a small perspex triangle, to which is applied x-rays of 220 kvp, 50 cm F.S.D. with a H.V.L. 2.2 mm Cu filter. The axillary glands are treated separately in these doses. Method 2 is post-operative, and includes the whole chest area; the x-rays being generated at 180-190 kv constant and filtered through a H.V.L. – 1.8 mm Cu filter. The integral dose delivered per 1000 r surface dose ranges from 2.5 megagram/r to 3.7 megagram/r. An altered RBC count and hemoglobin content sometimes occur here, usually accompanied by a fall in the leucocyte count. Nausea, vomiting, and general malaise are also reported. The value of irradiation in pre- and post-operative cases varies with the seriousness of the condition. Metastases in all sites are effectively treated by irradiation. (Results show arrest of the disease, restoration of function, relief of pain, and prolongation of life.) For glandular metastases, x-rays and radium are used. Radium doses of 1500-2000 r are used, followed by 2000-3000 r doses. Skin metastases respond to 10-20 r/hr and total doses of 4000 r are sometimes given. Bony metastases require doses up to 2000 r.

BIOLOGY AND MEDICINE (continued)

41 A method for the determination of the radiation dose produced by artificial radioactive substances in tissue. T. Wahlber. Acta Radiol. 30, 291-8(1948).

A method is described for the determination of the radiation dose and activity by means of ionization measurements when radioactive substances are distributed in the body. The relationship of equivalent r and mc units expressed in the equation 1 mc/g = 7.1 x 10^{-7} V_β e.r./sec, where V_β is the mean energy of the β-particle in ev, and e.r. is the equivalent roentgen defined as the energy absorbed per gram of air irradiated with a radiation quantity of one r, can be directly measured and tested by this apparatus. The radiation dose at a point within the body is measured by the ionization of an air-filled cavity around the point. The ionization is in turn defined in terms of electrostatic units/cm^3. The method of measurement is based on definitions and facts included in the article. Measurements show that the magnitude of the dose, within a margin of error, is the same whether the radioactive substance is distributed in water, soft tissue, or bone tissue.

42 New data on the radiotherapy of recurring herpes. J. Frankl. Ann. dermatol. syphili. 9, 168-70(1949) Mar.-Apr.

Local irradiation with soft x-rays was used in the treatment of recurring herpes in the inflammatory stage. Results are given of the treatment of 12 patients (9 women and 3 men) most of whom had been treated previously by various other methods. In 4 cases a single dose of 130 r was sufficient to effect a cure. In 8 cases it was necessary to repeat the treatment a second time using the same dose. There were no relapses over periods of 1 to 3 years. The authors realize the need for observation of a greater number of cases over a longer period of time before making definite conclusions as to the value of this method, but they feel that the method offers great promise in the treatment of recurring herpes.

43 The present status of the treatment of hyperthyroidism. George Crile, Jr. J. Intern. Coll. Surgeons 12, 229-33(1949) May-June.

An evaluation of present methods of treatment of hyperthyroidism is presented. The advantages and disadvantages of thyroidectomy and treatment with propylthiouracil or radioiodine are included. The doses necessary in the cases of Graves' disease hyperthyroidism and nodular goiter hyperthyroidism, upon which the radioiodine results are based, are included. The average initial dose in 80% of the Graves' disease cases is 4 mc, which is repeated in 2 or 3 months if it proves inadequate. In large nodular goiter cases as high as 16 mc is administered without danger of inducing hypothyroidism. The average dose, however, is about 10 mc. The one complication is a mild exacerbation of hyperthryoidism. No other complications are reported in 120 cases. Conclusions are that the treatment of hyperthyroidism should be individualized and any of the three methods described may be applicable to the particular case.

44 Radical amputation for cancer of the breast with and without irradiation. Claude C. Kennedy. J. Intern. Coll. Surgeons 12, 324-30(1949) May-June.

The results of treatments of breast cancer with surgery and radiation are described. One thousand-two hundred and twelve radical amputations are studied statistically in two classifications; those cancers confined to the breast, and those with metastatic formations. Five-year survival rates of 951 of these patients show that 70.3% in stage one survived, and only 33.7% in stage two. Thus, over half of the total number of patients survived. Charts of survival rates over much longer periods of time are included. No dosage levels for the x-ray treatments are revealed. Conclusions are that irradiation does not appreciably increase the survival time of patients in the two groups, but is very beneficial in cases of large tumors of both stages. The method of choice appears to be radical amputation of the breast cancer followed by x-radiation.

BIOLOGY AND MEDICINE (continued)

45 Radioiodine in the study and treatment of thyroid disease: a review. Mavis P. Kelsey, Samuel F. Haines, and F. Raymond Keating, Jr. J. Clin. Endocrinol. 9, 171-210(1949) Feb.

The diagnostic, therapeutic, and experimental uses of I^{131} are briefly covered with particular reference to the fate of I^{131} in the thyroid gland. Past and present uses of a series of radioactive isotopes of iodine in the study of general body metabolism and other problems are also reviewed. Radioiodine's rate of absorption, utilization, and excretion are discussed. The appearance of radioiodine in the ovaries, pituitary, lungs, kidneys, and liver is noted [Ariel et al, Am. J. Physiol. 132, 346(1941); Perlman et al, Endocrinology 30, 487(1942)]. The thyroid's ability to concentrate iodine through 2 methods, trapping inorganic iodide and converting organically bound iodine, is outlined. Factors such as antithyroid drugs and thyrotrophic hormone influence the metabolism of radioiodine by the thyroid. Hyperthyroidism, hypothyroidism, goiter, and other thyroid conditions have been studied through the use of radioiodine. 153 references.

46 Radioiodine in thyroid disease. George M. Curtis and M. Been Fertman. J. Intern. Coll. Surgeons 12, 254-60(1949) May-June.

An extensive review of the role of radioiodine in thyroid physiology is presented. Iodine absorption in the thyroid through four separate phases is described. The actions of various iodine inhibitors (such as thyrotrophic hormone and thiouracil), the goitrogenic effects of various foods, and the use of tracers in the studies of body metabolism are noted and briefly discussed. Recent results of studies of hyperthyroidism with I^{131} show that the average interval for obtaining normal metabolism is about 2 months. No relapses or recurrences are reported. Myxedema is one complication noted. Evidence is still lacking on the permanent effects of radioiodine therapy of various thyroid diseases and experience is not yet sufficient to warrant its wide-spread use. 46 references.

47 Radiotherapy of malignant intra-ocular neoplasms. H. B. Stallard. Brit. J. Ophthalmol. 32, 618-39(1948) Sept.

A description is given of the method of radon seed therapy used in glioma retinae cases. This therapy is essential in relieving pain and preserving vision. The procedure is given in detail. In order to permanently destroy the malignant neoplasm, the tumor-bearing areas are irradiated at a uniform intensity with 3500 r per quadrant of the interior of the eye. One and two mc radon seeds are used. Doses vary from 3350 r to 10900 r at the growth apex and from 7600 r to 30200 r in the surrounding regions per 168-hr periods. The outer sclera receives as much as 125,000-150,000 r during the entire course of the therapy. Some of the complications are lens opacities, retinal exudations around the macula, retinal hemorrhages, and retinal detachments. In the 15 cases described, the therapy proved effective.

48 Radium-D ophthalmic applicator treatment time. Harold Swanberg. Mississippi Valley Med. J. 71, 93-4(1949) May.

The author described the advantages of the Radium-D Ophthalmic Applicator, which emits pure β-rays rather than the mixed β- and γ-radiation produced by applicators using radium element or radon. The most common lesions treated were corneal, especially scars and vascularizations. The radiations are delivered by a 10 mc applicator through a 0.05 mm Al filter which allows greater β-transmission than formerly. The treatment times are necessarily longer than with radium element or radon, since the powerful γ-rays are eliminated. Recommended doses are 3 or $3\frac{1}{2}$ -minute periods weekly, which tend to reduce the incidence of local reactions caused by long treatment times. The β-rays prevent destruction of deeper-lying tissues in irradiation of the 1 mm thick cornea. There is also less danger to the operator, and greater stability of the applicator. Results are most gratifying.

BIOLOGY AND MEDICINE (continued)

49 Radium therapy of functional uterine bleeding. M. D. Joshi. J. Indian Med. Assoc. 18, 66(1948) Dec.

The treatment and dosage levels for radium therapy of functional uterine bleeding are presented. The average dose is 1200 Ra mg-hr for 24 hours in women, 200-300 Ra mg-hr in young girls, and around 500 Ra mg-hr in younger women. This therapy should not be applied in cases of uterine hemorrhage due to high blood pressure, back pressure, disease of heart or lungs, or various diseases of the blood. Unfavorable signs are septic focus in the pelvis and intrauterine submucus polypi. Results of treatment are very favorable, with little attendant destruction of ovarian activity.

50 Radiation injuries produced by contact roentgen therapy. Erik Poppe. Acta Radiol. 30, 365-70(1948).

Contact therapy dosages for skin cancer have been around 4-5000 r/treatment. Similar dosages of from 3-7000 r are also described. In 7 of 1384 cases treated, radiation injuries developed. Five of these were treated for henign lesions of the fingers or toes. For contact roentgen therapy of fingers and toes an additional filter should not be used. It would probably be an advantage to have an apparatus which may be used with a lower voltage than the Philips contact roentgen therapy apparatus, so that a still greater fall in intensity may be obtained, when this is desirable.

51 The roentgen ray therapy of lymphogranulomas. A. Vogt. Röntgen-Praxis 17, 110(1948) (in German).

Observations on lymphogranuloma cases indicate 10% are acute and defy treatment. The lifespan of those with acute lymphogranulomas is approximately 5.4 months. With the primary chronic form the lifespan of the sick has been increased to more than a year through x-ray treatments. An all around improvement of similar conditions is also reported. The dosages consist of 1800-2100 r over a course of 4 weeks, within a limited field. A rise in body temperature and a climb in the blood count should be avoided. Finally, however, a condition refractory to further radiation treatment is reached, and further loci of the disease cannot be reached or treated effectively.

52 Treatment of hyperthyroidism especially with radioactive iodine. Earle M. Chapman. J. Intern. Coll. Surgeons 12, 301-4(1949) May-June (See also Nuclear Science Abstract 1-1937).

The treatments now available to control a hyperthyroid condition are described and discussed. Iodine medication and surgery are noted. Radiation therapy is traced from the earliest applications of radium in 1901 to present methods of radium treatment, external roentgen radiation, and internal irradiation from isotopic iodine. The average dose of I^{130} administered by mouth to 65 patients was 32 mc. Fifty patients responded well, while 6 developed radiation sickness, 11 developed hypothyroidism, 3 suffered toxic effects from the treatments, and one died. The average dose of I^{131} given 100 patients was 8 mc. Seventy-eight responded well; complications were few. Iodine alone, propyl or methylthiouracil, subtotal thyroidectomy, external radiation with x-ray and internal radiation with I^{131} are all effective methods in the treatment of hyperthyroidism.

53 The treatment of thyroid carcinoma: a review. Arthur A. Axelrad. McGill Med. J. 18, 89-101(1949) Apr.

The methods of differentiation between carcinogenic tumors of the thyroid, the therapies indicated, and the innovations in technique through the years are included in this informative review. The role of radioactive oidine as a diagnostic and therapeutic aid is traced from the important discovery of its value for relieving metastatic thyroid adenocarcinomas and hyperthyroid conditions through present investigations. Administration of thyroid-stimulating hormone, followed by radioiodine was found to be effective in causing retention of I^{131}. Evidence as to the histologic effect of internal irradiation on the thyroid is only fragmentary; some fibrosis of the thyroid has been noted [Chapman and Evans, J. Am. Med. Assoc. 131, 86(1946)]. Acute thyrotoxicosis, following a large dose of I^{131}, may occur, accompanied by cardiac decompensation, a transient hypoalbumenaemia, leukopenia, impaired renal function, and evidence of hepatic dosage. Few effects of internal irradiation of other organs are known. 48 references.

BIOLOGY AND MEDICINE (continued)

54 The treatment of thyrotoxicosis. I. S. Ravdin, Edward Rose, and James D. Maxwell. J. Am. Med. Assoc., 140, 141-6(1949) May 14.

The methods of treatment of thyrotoxicosis are reviewed. These consist mainly of administration of iodine, goitrogen compounds, external irradiation of the thyroid or pituitary, internal irradiation from I^{131}, and thyroidectomy. External irradiation of the thyroid has been abandoned except in cases of Graves' disease. The use of radioactive iodine is limited to cases of Graves' disease of or recurrent postoperative thyrotoxicosis. Satisfactory results occur in 70-80% of the cases. Complications such as myxedema, radiation tracheitis and esophagitis may result. Results indicate that radioactive iodine has had too limited a trial to permit final conclusions regarding its efficacy and safety.

55 Treatment of uterine fibroids with radium. M. T. F. De Gaudino. Toko-Ginecologia Practica 7, 1-10(1948)(in Spanish).

Observations on 510 cases of uterine fibroids treated with radium indicate that this procedure is innocuous and works with utmost effectiveness. No mortality, no adverse effects on the ovaries, no alterations in the reflex phenomena, phychic equilibrium, or fertility of the patients occurred. Four cases of pregnancy subsequent to the treatment are reported.

56 The use of propyl thiouracil and of radioactive iodine. Robert C Grauer. Penn. Med. J. 52, 704-7(1949) Apr.

The uses of radioactive iodine in the treatment of thyrotoxicosis and carcinoma of the thyroid are summarized along with the presurgical use and the toxic effects of thiouracil. I^{131} is used in varying dosages according to the individual case. Its use in the treatment of thyrotoxicosis is extremely limited and no long range effects are known as yet. Mention is made of Soley's work on 33 patients, which yeilded unfavorable results [Medical Clinics of North America 3, 17(1948)]. The development of toxicity such as thyroid crisis, leukopenia, and marked permanent myxedema is inevitable. Radioactive iodine is not very effective in carconoma therapy since only 15% of thyroid carcinomas pick up the isotope in some degree, and none retain it [Marinelli et al, Am. J. Roentgenol. and Radium Therapy 58, 17(1947)]. 16 references.

57 X-Ray treatment in osteo-arthritis. F. Hernaman-Johnson. Rheumatism 5, 44-7(1949) Apr.

A review of x-ray therapy is made, indicating its resolving effect on acute and chronic inflammations, its help in causing absorption of pathological fibrous tissue, and its aid in promoting the formation of fibrous defensive tissue. The specific treatment of osteoarthritis of the hip-joints by x-radiations is described. Doses of 50 r a week are used for painful inflammations. Where stiffness occurs, 100-200 r per week is advisable. Dosages are flexible, according to the patient's reactions. Beneficial results such as a reversal of organic changes in the hip-joints have been noted, while toxic effects are few.

58 Analysis of radio-iodine uptake and excretion curves. T. H. Oddie. Brit. J. Radiology 22, 261-7(1949) May.

Mathematical formulas based on the established metabolism of iodine have been developed for the analysis of the uptake and excretion curves for radio-iodine. Typical values of numerical constants involved are calculated from other published work, and the use of these formulas is suggested to enable comparisons to be made between the work of various investigators.

59 A background for biological studies with radioiodine. William T. Salter. Science 109, 453-6(1949) May 6.

The history and development of iodine as a therapeutic aid are traced to the present time. The author advises that the role of radioiodine in iodine metabolism and thyroid physiology studies should be clearly pointed out. One of the points stressed is that biophysical methods should be adapted to the organism rather than the converse.

BIOLOGY AND MEDICINE (continued)

60 The effect of substrates on the endogenous metabolism of living yeast. John M. Reiner, Howard Gest, and Martin D. Kamen. Arch. Biochem. 20, 175-7(1949) Jan. (Letter to the editor).

The extent of conversion of C^{14} labeled reserve materials to CO_2 in yeast under varying conditions is summarized. Radioactive glucose and acetate were assimilated by glucose-grown S. cerevisiae in M/15 KH_2PO_4 until the substrate was exhausted. The cells then were exposed to inactive glucose, inactive acetate, or no substrate at all in a Warburg apparatus. The CO_2 was estimated with a Geiger-Mueller counter. Results are given in two tables. Conclusions indicate endogenous metabolism in yeast is accelerated by the presence of substrate.

61 Excretion of radioactive carbon dioxide by rats after administration of isotopic bicarbonate, acetate, and succinate. R. Gordon Gould, F. Marott Sinex, I. N. Rosenberg, A. K. Solomon, and A. Baird Hastings. J. Biol. Chem. 177, 295-301(1949) Jan.

Experiments on the rate of excretion of $C^{14}O_2$, following the injection into white rats of isotopic bicarbonate, isotopic acetate, and isotopic succinate labeled with C^{14} atoms, are described. The preparation of the isotopic solutions used and the method of $C^{14}O_2$ measurement are given in detail. Data on the cumulative excretion of $C^{14}O_2$ and on the distribution of isotopic carbon in glycogen, fatty acids, and cholesterol isolated from the livers of the rats are included. The velocity constants for the conversion of acetate and succinate carboxyl carbons to CO_2 and for the excretion of CO_2 are calculated. The cumulative excretion of C^{14} in 4 hrs amounted to 95% after the bicarbonate, 87% after the acetate, and 86% after the succinate administration.

62 Fixation of isotopic nitrogen by clostridium. Eugene D. Rosenblum and P. W. Wilson. J. Bact. 57, 413-4 (1949) Apr.

Experiments initiated to determine, through the use of isotopic nitrogen, N^{15}, the nitrogen fixation abilities of 15 species of the genus Clostridium are described. The results obtained, in which C. pasteurianum was used as the control, are given in a table. Three species (C. sporogenes, C. perfringens, and C. acidiurici) showed no nitrogen fixation properties. Possible reasons for the results in these three cases are discussed.

63 Further studies on radioiron in avian malaria. Paul E. Thompson, D. A. McGinty, Mary L. Wilson, and Anita Bayles. J. Parasitol. 35, 215-6(1949) Apr. (Research note) (See also Nuclear Science Abstract 1-1057).

Recent studies on canaries and ducks to determine the influence of radioiron ($Fe^{55,59}$) on the morphology and staining reactions of the malarial parasite, Plasmodium cathemerium, indicate that the radioactive substance, when incorporated into the hemoglobin before infecting and when present up to an activity of 1.1 mc/ml of blood, does not have an influence on the course of the infection or the morphology of the parasites. A table is included which lists the experiments run and their individual results.

64 The influence of insulin and adrenal cortical compounds on the metabolism of radioactive C^{14}-glucose in the isolated rat diaphragm. Grant R. Bartlett, Arne N. Wick, and Eaton M. MacKay. J. Biol. Chem. 178, 1003-4(1949) Apr. (Letter to the editor).

The results of experiments following the distribution of radioactive C^{14}-glucose in the isolated diaphragm of normal rats under the influence of insulin, desoxycorticosterone, and corticosterone are summarized in tabular form. Insulin causes a 2 to 3-fold increase in glycogen by accelerating the pathway from glucose to glycogen. Desoxycorticosterone and corticosterone inhibit glycogen deposition. According to the experiments, only a small percentage of the utilized glucose appears as glycogen and CO_2.

BIOLOGY AND MEDICINE (continued)

65 Infrared spectrometry in metabolic studies with deuterium-labeled steroids. Konrad Dobriner, Theodore H. Kritchevsky, David K. Fukushima, Seymour Lieberman, Thomas F. Gallagher, James D. Hardy, R. Norman Jones, and G. Cilento. Science 109, 260-1 (1949) Mar. 11.

Investigations and procedures for the detection of deuterium steroids, through the use of infrared spectrometry on extracts containing a number of closely related compounds, are described. The material examined was recovered without loss or alteration. With an increase in the number of deuterium atoms in the steroid, there is a progressively greater change in the spectrum between 700 cm^{-1} and 1,300 cm^{-1}, as well as an increase in intensity of the bands at 2,165 cm^{-1} and 2,145 cm^{-1}. The C-D absorption bands of 2,150 cm^{-1} range are particularly useful for the detection of a deuterium-containing molecule. Allopregnan-5, 6-d_2-ol-3(β)-one-20-acetate was injected into a normal woman, and a 20-day collection of feces and urine was analyzed. Results showed crude α- and β-hydroxy ketonic fractions as well as α- and β-hydroxy non-ketonic fractions in the C-D band of both the urine and feces.

67 Radioactive materials and their medical uses. S. B. Osborn. Pharm. J. 162, 289-91 (1949) Apr. 16.

A review of the nature, measurements, and clinical use of radioactive isotopes is presented. Radioactive iodine is used for the measurement of thyroid activity and for the localization of functional metastases of the thyroid. P^{32} is used in estimating blood volume, and for differentiating carcinoma of the breast from inflammatory conditions. Na^{24} aids in the estimation of extracellular fluid, the rate of blood circulation, and the level at which amputation in gangrene cases should take place. I^{131} is mentioned as having therapeutic use in carcinoma and hyperthyroid cases. Dosage levels are given in a table. P^{32} is used therapeutically for polycythemia vera, Hodgkin's disease, various leukemias, and lymphosarcomas. Radiostrontium is used in treating generalized carcinomatosis of bone. [Lawrence Am. J. Roentgenol. and Radium Therapy 48, 283(1942)]. 33 References.

68 Regression of a radioactive mercurial diuretic from the plasma of man. C. T. Ray, S. A. Threefoot, G. E. Burch, P. B. Reaser, W. J. Overman, W. H. Gordon, J. M. Milnor, and J. A. Cronvich. Nature 163, 640-1(1949)Apr. 23 (Letter to the editor).

The pharmacodynamics of mercurial diuretics was studied through the use of mercury-203-205 incorporated in mercuhydrin, the sodium salt of methoxyoximercuripropylsuccinylurea. The concentration-time course of the isotope in the plasma of man after intravenous injection was studied for periods of 100-180 min. The procedure and regression curves are included. Explanations of the three regression-rates are outlined. The first regression rate shows mixing of the mercury in the plasma; the second probably illustrates the filling of the potential mercury spaces and the activation of potential turnover patterns; the third reflects the elimination of the mercury. A more detailed discussion appears elsewhere.

69 Studies on the methane fermentation. VII. Tracer experiments on the mechanism of methane formation. Thressa C. Stadtman and H. A. Barker. Arch. Biochem. 21, 256-64 (1949) Apr.

Experiments on methane fermentations of acetate and ethyl alcohol through the use of C^{14} labeled CO_2 and acetic acid, are described. The preparation of the C^{14}-labeled substrate is not given. The materials, methods, and experimental results are included. The methane formed by the fermentation of acetic acid in the presence of C^{14}-labeled CO_2 is only slightly labeled. Conclusions are that the methane is derived mainly from the methyl group, and the CO_2 comes from the carboxyl group. An increasing amount of CO_2 is converted to methane. The methane formed in the fermentation of ethyl alcohol is derived from CO_2 and not from the alcohol or acetic acid. 16 references.

BIOLOGY AND MEDICINE (continued)

70 Studies on the role of the cerebrospinal fluid in brain metabolism as measured with radioactive phosphate. L. BaKay and Olov Lindberg. Acta Physiol. Scand. 17, 179-90 (1949).

The metabolism of the brain was studied with the help of P^{32} injections into the cisterna magna region of rabbits. The technique, results, and conclusions are given. The speed with which P^{32} entered the brain through the cerebrospinal fluid was determined. The radioactivity within the different parts of the brain increased at approximately the same rapidity, the maximum time being 35 minutes. The turnover of radioactive orthophosphate to organic bound phosphate in the brain was measured. Results indicate that some minor parts of the brain, such as the hypophysis, pineal body, and the plexus chorioidei are supplied mainly through the blood. The nervous tissue seems to exchange phosphate via the cerebrospinal fluid. 20 references.

71 A study of the conversion of tryptophan to N′-methylnicotinamide using isotopic carbon. James M. Hundley and Howard W. Bond. Arch. Biochem. 21, 313-4(1949) Apr. (See also Nuclear Science Abstract 1-369).

Data obtained by the use of C^{13} compounds in the rat indicate that the carboxyl carbon of tryptophan is not incorporated into the N′-methylnicotinamide molecule during a supposed synthesis of nicotinic acid. The synthesis of isotopic tryptophan is described elsewhere [Bond, J. Biol. Chem. 175, 531(1948)]. The experiments and the results serve to strengthen the hypothesis of Mitchell and Nyc that the synthesis of nicotinic acid proceeds via 3-hydroxy-anthranilic acid. The isolation of N′-methylnicotinamide in considerable amounts during the experiments verifies an existing theory.

72 Tracer experiments on the mechanism of synthesis of valeric and caproic acids by clostridium kluyveri. E. R. Stadtman, Thressa C. Stadtman, and H. A. Barker. J. Biol. Chem. 178, 677-82(1949) Apr.

The methods of condensation of butyric acid with ethanol in the formation of caproic acid and the condensation of ethanol with propionic acid in the formation of valeric and other acids were investigated through the use of C^{14}. The procedures and data are given. The results show that the caproic acid formed in the fermentation synthesis is labeled with C^{14} only in the β position. Therefore, the synthesis is a condensation of the carboxyl carbon of butyric acid and C_2 compound derived from ethanol. Propionic acid is shown to be converted to n-propanol; n-valeric, and n-heptanoic acids are converted in a similar manner.

73 Tracer experiments on the mechanism of uric acid decomposition and acetic acid synthesis by clostridium acidi-urici. J. L. Karlsson, and H. A. Barker. J. Biol. Chem. 178, 891-902(1949) Apr.

The fermentation of purines by Clostridium acidi-urici has been investigated by the use of C^{14}-labeled uric acid, glycine, and carbon dioxide. The results show that the methyl carbon of the acetic acid formed when uric acid is fermented in the presence of excess glycine and bicarbonate is derived from the 2, 5, and 8 positions of uric acid, the methylene carbon of glycine, and carbon dioxide. The acetic acid carboxyl carbon is derived mainly from the latter two sources and from the 5 position of uric acid. The carbon dioxide formed in the fermentation comes mostly from the 2, 4, and 8 positions of uric acid, and to a lesser extent from the 6 position, and from the carboxyl group of glycine. Several compounds including 5-amino-4-imidazolecarboxamide have been eliminated as likely intermediates in the purine fermentation.

74 The zone of localization of anti-mouse-kidney serum as determined by radioautographs. David Pressman, Ruth F. Hill, and Frank W. Foote. Science 109, 65-6(1949) Jan. 21.

By intravenously injecting mice with a radioiodinated form of the globulin fraction of anti-mouse-kidney serum, the determination of the region of localization of this serum within the kidney was made possible. Radioautographs of the kidney tissue, taken 5 days after injection, revealed that the localization of the radioactivity and presumably the radioantibody was taking place in the glomeruli of the

BIOLOGY AND MEDICINE (continued)

kidneys, and was not due to a non-specific pickup by the kidney of foreign substances or to the fact that the radioactive material may pass through the kidney in its excretory phase. The concentration of radioactivity in the kidneys of these animals is greater than the concentration in those of the control animals. This indicates the localization must have been due to the kidney antibodies.

CHEMISTRY

75 Analytical chemistry of the manhattan project. Chapter XXVIII. Aluminum, gallium, indium, and thallium. L. G. Bassett and F. S. Tomkins. AECD-2599, nd. Decl. May 25, 1949. 20p. For publication in NNES.

This chapter deals with the analytical chemistry of Group III-B elements with the exception of boron. Methods and procedures reported in detail for the determination of aluminum, include the following: gravimetric (peroxide-hydroxide and 8-hydroxyquinoline), and colorimetric (hematoxylin, aluminon (a) alkaline medium, (b) neutral medium, (c) acid medium, 8-hydroxyquinoline, and alizarin red S). Brief references are made to the colorimetric and spectrographic determination of gallium, indium, and thallium.

76 A method for the determination of traces of metals: Mercury cathode electrolysis, followed by distillation of the mercury and polarographic or colorimetric examination of the distillation residue; related procedures. I. Outline of the method. C. E. Bricker, N. H. Furman, and Bruce McDuffie. AECD-2600, Oct., 1947. Decl. May 25, 1949. 16p. For publication in NNES.

This work originated with the purpose of determining minor amounts of cadmium in uranium and related materials. The use of a small (2 ml) mercury cathode as a collector for traces of electrolyzable metals has been tested for a variety of materials that can be brought into dilute sulfuric acid solutions. The metals that are deposited are separated from mercury by distillation of the latter, after which sensitive methods such as polarography and spectrophotometry may be applied to the analysis of the residue.

77 A method for the determination of traces of metals. II. Studies of the electrolysis of metals into mercury cathodes. C. E. Bricker, N. H. Furman, and Bruce McDuffie. AECD-2601, Oct., 1947. Decl. May 24, 1949. 12p. For publication in NNES.

Some details of the electrolysis of small quantities of various metals into a mercury cathode from concentrated uranyl solutions have been presented. The U(IV)-U(III) mixture that is formed may prevent the deposition of chromium and molybdenum in a mercury cathode, provided the solution is rather concentrated in uranium. Iron is frequently found to divide between mercury cathode and solution. The presence of traces of metals that affect the overvoltage of hydrogen at the mercury cathode appears to be a contributing factor. The use of redox potential buffers other than the U(IV)-U(III) system as a device for controlling group separations in electrolysis with mercury cathodes has been suggested.

78 A method for the determination of traces of metals. III. Studies of the distillation of amalgams. C. E. Bricker, N. H. Furman, and Bruce McDuffie. AECD-2602, Oct., 1947. Decl. May 24, 1949. 9p. For publication in NNES.

It has been demonstrated that the electrolysis-distillation stages of a procedure that has been developed for traces of metals may be utilized, with certain precautions to recover milligram quantities of cadmium, cobalt, copper, iron, nickel, and zinc. Lead remains partially as undissolved lead sulfate and hence the recovery of amounts ranging from 1 to 5 mg is not advisable by this procedure.

79 A method for the determination of traces of metals. IV. Polarographic studies. C. E. Bricker, N. H. Furman, and Bruce McDuffie. AECD-2603, Nov., 1947. Decl. May 24, 1949. 33p. For publication in NNES.

A brief review has been given of the facts that were established with regard to the polarography of the residues obtained by mercury cathode electrolysis followed by distillation of the mercury cathode.

CHEMISTRY (continued)

80 Analytical chemistry of the manhattan project. Chapter XX. Fluorine and fluorocarbons. G. W. Busch, R. C. Carter, F. E. McKenna, H. F. Priest, and E. Staple. AECD-2604, nd. Decl. May 24, 1949. 86p. For publication in NNES.

The methods of solution of fluorine containing compounds and the methods of separating fluorine from the mixtures in solution are first discussed. Detailed procedures are then given for the various gasometric, gravimetric, volumetric, colorimetric, fluorimetric, polarographic, spectrographic, and enzymatic methods of determining fluorine content. Analytical procedures for the determination of the various constituents of fluorocarbons are also given. 115 references.

81 Analytical chemistry of the manhattan project. Chapter XXII. Chlorine, bromine, and iodine. R. G. Mansfield and D. H. Templeton. AECD-2607, Sept. 22, 1948. Decl. May 24, 1949. 33p. For publication in NNES.

The methods of solution for samples containing Cl, Br, and I are first discussed. Following this detailed procedures are given for the determination of these elements. Among the types of methods discussed are gravimetric, volumetric (Votocek, Volhard, micropotentiometric, micro-thiosulfate), nephelometric, and colorimetric (o-toluidine, and iodine in chloroform). 44 references.

82 Analytical chemistry of the manhattan project. Chapter XXVII. Germanium, tin, and lead. R. E. Telford and N. H. Furman. AECD-2612, nd. Decl. May 25, 1949. 19p. For publication in NNES.

Methods of solution, separation and determination are presented for each of the above elements. The analysis of Project materials for these elements was for the most part limited to the determination of minor amounts of lead in a great variety of materials. Occasional determinations of germanium and tin in certain alloys or for other purposes were necessary. 37 references.

83 Analytical chemistry of the manhattan project. Chapter VI. Electrolytic separation methods. Clyde C. Casto. AECD-2617, nd. Decl. June 2, 1949. 48p. For publication in NNES.

Considerable development work has been done on mercury cathode electrolysis in acid solution; a summary of this work is presented. The use of the mercury cathode for the purification of uranium solutions is discussed. Electrolysis from sulfuric acid media and the deposition rate as a function of various factors are considered. Further discussion covers the use of the mercury cathode in the determination of impurities in uranium compounds; techniques and equipment for minimizing anodic oxidation; electrolytic deposition of uranium on solid metal cathodes; the deposition of uranium using a buffer solution of sodium or ammonium acetate with acetic acid, ammonium oxalate, and sodium fluoride solutions; the effect of various factors upon the composition of the electrodeposit; the deposition of uranium from sodium fluoride medium; deposition of uranium on nickel and copper; and the electrodeposition of thorium on a solid metal cathode. 45 references.

84 Analytical chemistry of the manhattan project. Chapter XXVII. Scandium, yttrium, and raré earths. L. L. Quill and C. J. Rodden. AECD-2618, nd. Decl. June 2, 1949. 26p. For publication in NNES.

Various methods for separating the above elements from uranium and thorium are given; precipitation, extraction, and volatilization procedures are given in detail. Gravimetric and spectrophometric methods for determining the individual rare earths and scandium and yttrium are discussed.

85 Spectrophotometric determination of ruthenium. E. D. Marshall and R. R. Rickard. AECU-224, May 5, 1949. 19p.

Ruthenium and many of its compounds can be converted to the water soluble potassium ruthenate by alkali-nitrate fusion. The ruthenate is stable in 2M potassium hydroxide solution and is highly colored. A quantitative method for the determination of ruthenium, based on the spectrophotometric measurement

CHEMISTRY (continued)

of the absorption of potassium ruthenate at 465 millimicrons wavelength, has been developed. The range of the method is from 1.0×10^{-4} to 4×10^{-4} M ruthenate in the solution measured. The 95% confidence interval is ± 3% of the ruthenium present with no interference from the other platinum metals or the common anions.

86 A rapid electrical method of separating carrier-free radioactivities. Warren M. Garrison, Herman R. Haymond, and Roy D. Maxwell. AECU-228, Mar. 15, 1949. 3p.

The apparatus consisted of a stack of filter papers moistened with electrolyte and placed between Pt electrodes. The sample solution containing one or more carrier-free radioelements was evaporated onto a filter paper and placed in the center of the stack. By a proper choice of complexing ions and pH, the desired activity could be moved to either one of the electrodes or retained at the initial position in the center of the stack. Recovery of the activity consisted in removing filter papers from the appropriate region of the stack. The following separations are described in detail: radio-columbium from manganese dioxide precipitate, radio-columbium and radio-zirconium from radio-ythrium and rare earth activities, and radio-arsenic from copper hydroxide carrier.

87 Inorganic paper chromatography. Michael Lederer. Nature 163, 598-599(1949) Apr. 16 (Letter to the editor).

Techniques for the separation of various metals are referred to. A list of Rf (rate of flow) values covering uranium, copper, cadmium, and other ions is included. Investigations with butanol and other solvents are described.

88 Quantitative separation of tellurites and tellurates; applications for the study of isotopic exchanges. M. Haissinsky and M. Cottin. Analyt. Chim. Acta. 3, 226-7(1949) Mar. (in French).

At pH 4.2 tellurous acid is precipitated and telluric acid remains in solution, the separation being quantitative. The isotopic exchange of tellurium between the two anions in acid solution, studied by this method of separation, is insignificant or extremely slow between 18 and 95°C.

89 The spectrophotometric determination of rutin and quercetin in mixtures. R. V. Swann. J. Pharmacy and Pharmacol. 1, 323-9(1949) May.

The preparation of pure rutin and quercetin and photometric methods of assay of their mixtures are described. Absorption spectra of rutin and quercetin, solvents, and formulas used in the process are included. A comparison is drawn between English and American methods of rutin assay. The rapid method detailed here provides for the correction of the gross absorption of the binary mixture by allowing for the absorption due to the minor constit[illegible] the mixture.

90 Application of thenoyl trifluoracetone (TTA) extraction to the preparation of radioisotopes. I. Purification of scandium and preparation of Ca^{45}. Abraham Broido. AECD-2616, July 29, 1947. Decl. June 1, 1949. 14p.

A rapid method is proposed for the purification of scandium and the preparation of carrier-free Ca^{45} from neutron bombarded scandium. The method depends on the extraction of the metal-TTA chelates into benzene from an aqueous solution of controlled pH. The equilibrium constants for the reactions at room temperature (~25°C) are given. The purification of scandium from several elements including rare earths was demonstrated by a single batch extraction at pH ~ 1.5. The preparation of carrier-free Ca^{45} was demonstrated and its radiation characteristics were confirmed.

91 Availability and sources of the ninety-six elements in high purity forms. Elwin H. Covey. AECU-222, Mar. 1, 1949. 83p.

This source list has been compiled to meet the needs of two types of readers: the research worker who needs detailed information on the elements listed, and the purchasing agents, perhaps a non-technically

CHEMISTRY (continued)

trained person, who obtains such materials for the research worker. Information as to the availability and sources of the 96 elements is clarified by considering the following points: pure forms of element obtainable, detailed information as to kind and amount of impurities present, availability of metal elements in metallic form, analytical information given by suppliers and additional sources, and availability of macro quantities of the elements.

92 Conference on isotopic exchange reactions and chemical kinetics, December 1-3, 1948. AECU-226, nd. 265p.

The various papers given at the second of the Brookhaven National Laboratory chemistry conferences are listed below:

The use of C^{14}, N^{15} and deuterium in studying catalytic reactions and adsorption processes on iron catalysts. J. T. Kummer and P. H. Emmett.

Reactions of isotopic propanes and butanes in the presence of aluminum halide catalysts. O. Beeck, J. W. Otvos, D. P. Stevenson, and C. D. Wagner.

Isotopic effects in some simple chemical processes. P. E. Yankwich.

Theory of isotope effects in chemical reaction rates. Jacob Bigeleisen.

Stable and unstable isotopes in catalytic research. John Turkevich.

Metal exchange reactions of some chromium, zinc, and vanadium complexes. C. S. Garner.

Complex ions of ethylene diamine tetra acetic acid. F. A. Long, S. S. Jones, and M. Burke.

Exchange between Co^{2+}, Co^{3+} and their hexamino compounds. K. J. McCallum.

Electron transfer between identical and different cobaltous and cobaltic amine complexes. W. B. Lewis and C. D. Coryell.

Applications of radioactive chlorine to the study of mechanisms of interaction of chlorine oxidation states. Henry Taube and Harold Dogen.

The exchange of iodine atoms between iodine and iodate ion. R. E. Connick and Z. Z. Hugus, Jr.

The mechanism of the chromic acid oxidation of isopropyl alcohol. F. H. Westheimer.

The kinetics of the vapor phase exchange of radioactive bromine between trichlorobromomethane and bromine. N. Davidson and J. H. Sullivan.

Spectrophotometric and radiochemical investigation of the interaction between different oxidation states of an element. J. Whitney, C. I. Browne, H. McConnell, and N. Davidson.

The kinetics of the thallium(I)-thallium(III) exchange reaction. R. J. Prestwood and A. C. Wahl.

Exchange reaction between the different oxidation states of thallium. G. Harbottle and R. W. Dodson.

Technique and apparatus for diffusion separation of ferrous and ferric perchlorates. L. Van Alten and C. N. Rice.

93 The decomposition of diphosphopyridinenucleatide (DPN) and adenosinetriphosphate (ATP) by ultraviolet light. C. E. Carter. AECU-232, Apr. 26, 1949. 13p.

Resolution of the products of the reactions of DPN and ATP with ultraviolet light by techniques of partition paper chromatography is reported. The data indicate that several reactions take place in the decomposition of DPN by ultraviolet radiation including photochemical changes in the pyridinium moiety of the molecule and rupture of the nucleoside and nucleotide linkages. The loss of coenzyme function of DPN, the ability to function in hydrogen transport mechanisms by virtue of reversible hydrogenation of the quaternary nitrogen of the pyridinium base, is probably associated with the first of these reactions. The labilization of the nucleoside linkage in ATP by the pyrophosphate group is shown by the identification of adenine as a product of the ultraviolet degradation of ATP, whereas adenosine and adenylic acid remained unchanged following exposure to ultraviolet radiation. The identification of adenine as a product of the decomposition of DPN indicates that the pyrophosphate linkage in this molcule exerts a similar effect.

CHEMISTRY (continued)

94 Isotope effect in the decarboxylation of labelled malonic acids. Jacob Bigeleisen. J. Chem. Phys. 17, 425-6(1949) Apr. (Letter to the editor).

The kinetic investigations of the reactions for malonic acid in glacial acetic acid and in pure liquids are given. These involve deviations in the ratio of rates of evolution of $C^{14}O_2$ and $C^{12}O_2$ with changes in temperature. Equations for the decomposition of the CO_2 formed at any time are included. Disagreement between theory and experiments is independent of the model of the activated complex chosen since the reciprocal of the specific activity of CO_2 at complete decarboxylation is a function of the masses in the normal molecules alone.

95 Note on the synthesis of succinic acid labeled in the carboxyl position with radioactive carbon. Yale J. Topper. J. Biol. Chem. 177, 303-4(1949) Jan.

The synthesis of isotopic succinic acid labeled with C^{14} in the carboxyl position is described. This synthesis was necessary to further studies in intermediary carbohydrate metabolism. The succinic acid was prepared from $BaC^{14}O_3$ via acetylenedicarboxylic acid according to the method of Gilman and Haubein [J. Am. Chem. Soc. 67, 1420(1945)]. The procedure is described in detail. The overall yield from $BaC^{14}O_3$ was 11%.

96 Preparation of p-dimethylaminoazobenzene containing isotopic nitrogen. William S. Fones and Julius White. Arch. Biochem. 20, 118-24(1949) Jan.

The preparation of p-dimethylaminoazobenzene (DAB) containing N^{15} in each of three positions is described. The flow sheet lists the reactions in detail. The N^{15} was contained in the aniline residue, in the dimethylamino group of the p-aminodimethylaniline moiety, or in the amino group of the p-aminodimethylaniline residue. The procedure for the first two types was essentially that of Allen and Wilson [J. Am. Chem. Soc. 65, 611(1943)] with the substitution of sodium hypochlorite for the bromite. Very good yields resulted. Difficulties occurred in preparing the third type of DAB which was finally obtained by a modified Hauser-Renfrow amine reaction [J. Am. Chem. Soc. 59, 122(1937)], and a reductive methylation step after the manner of Emerson and Uraneck [J.Am. Chem. Soc. 63, 749(1941)].

97 The course of a ray hydrolysis of simple halogen-benzol compounds. H. Minder, W. Minder, and A. Liechti. Radiologia Clin. 18, 108-26(1949) Mar. (in German).

Investigations and results are presented on the breakdown of simple substances by roentgen radiation. The substances used are water solutions of monochlorobenzene, monobromobenzene, o-dichlorobenzene, and p-dichlorobenzene. Dosage levels varied from 1500 to 50000 r and 4 tables are presented showing the degree of hydrolysis in each case. The divalent reaction follows a recent established theory. With small doses the proportional relationship between radiation r and hydrolysis is not maintained. In the range 5,000-10,000 r a linear relationship between dosage and hydrolysis rate is established. 17 refs. 6 figs. 5 tables.

100 Investigation of electron shells by spectroscopic methods. H. Kopfermann, W. Finkelnburg, H. Hoyer, J. Goubeau, K. Schäfer, and Th. Förster. FIAT Review of German Sciences 1939-1946, Physics of the Electron Shells 1-68(1948). (in German).

This is a survey of work on electron shells by spectroscopic methods done by German physicists in the years 1939-1946. The article has 3 parts: atomic spectra, continuous spectra, and molecular spectra. Subjects related to atomic physics are discussed in the first two parts. In atomic spectroscopy, only work on details was performed in the period surveyed, owing to the relatively advanced state of knowledge in this field. This applies to the Zeeman effect, the linear Stark effect, the hyperfine structure, as well as to the study of the production methods, the intensity, and the width of spectral lines. However, some important progress was made in the investigation of the quadratic Stark effect [Kopfermann, et al. Z. Physik. 117, 145 and 156 (1941); 120, 545 (1943); Gabler, Physik. Z. 42, 67 (1941)]. Among the

CHEMISTRY (continued)

continuous spectra, those at the series limits and those produced through electron decelerations retained the attention of several workers. The study of the latter effect, hitherto known in the x-ray region only, was partly concerned with the question whether electron decelerations might not play an important part in the visible region also [Finkelnburg, Z. Physik 116, 214 (1940); Hahn and Finkelnburg, Z. Physik 122, 23 (1944)].

101 Nuclear quadrupole effects in the microwave spectrum of the asymmetric top molecule, vinyl chloride. J. H. Goldstein and J. K. Bragg. Phys. Rev. 75, 1453-4(1949) May 1. (Letter to the editor).

A preliminary report of the analysis of the observed hyperfine structure in the microwave spectrum of the asymmetric-top vinyl chloride molecule is given. The principal lines in the K-band spectrum and the frequencies corrected for quadrupole shift, together with the values of the rotational constants and the quadrupole coupling parameters are given.

102 Applications of radioactivity to the study of chromatographic analysis. Monique Martin, Yang Jeng-Tsong, and Pascaline Daudel. Analyt. Chim. Acta 3, 222-5 (1949) Mar. (in French).

With the help of radioactive elements the fixation of the ions Cl^-, Br^-, and I^- on chromatographic columns has been studied. A study has also been made of the chromatographic equilibria of systems containing a mixture of two of the above-mentioned ions. The observed order of the intensities of chromatographic adsorption is the same as that obtained in the case of the amberlites. It is not in accordance with the law concerning ionic radii but may be interpreted by means of the electronegativities of Pauling.

103 Radioactive tracers used in corrosion studies. C. G. Bacon. Gen. Elec. Rev. 52, 7-9(1949) May.

Autoradiographs are shown and discussed which illustrate the use of radioactive isotopes of the elements, which commonly participate in corrosion reactions, in the study of corrosion processes. By means of such tracers, a photographic plate, and a Geiger counter, it is possible to follow a series of chemical changes and combinations.

104 The volatility of plutonium dioxide. T. E. Phipps, G. W. Sears, and O. C. Simpson. AECD-2608, nd. Decl. May 25, 1949. 30p. For publication in NNES.

The volatility of plutonium dioxide has been measured in the temperature range 1320°C to 1790°C by a modification of the Knudsen effusion method [Ann. Physik 29, 179(1909)]. The plutonium dioxide was heated in vacuum in a tantalum oven. Under these conditions the dioxide was reduced to a lower oxide, or oxides, which maintained a constant reproducible vapor pressure throughout further heating. Either an oxide was formed which was stable under the conditions of the experiment or thermal reduction continued with the formation of a second solid of liquid phase. The thermal reduction of the oxide was reversed by heating the reduced oxide in a low pressure atmosphere of oxygen.

105 The vapor pressure of plutonium halides. T. E. Phipps, G. W. Sears, R. L. Seifert, and O. C. Simpson. AECD-2609, nd. Decl. May 25, 1949. 34p. For publication in NNES.

Accurate quantitative determinations can be made for very small amounts of plutonium compounds by the methods of radio-chemical assay. This fact made it possible to determine the vapor pressure of plutonium compounds by a modification of the Knudsen effusion method, [Ann. Physik 29, 179(1909)]. Vapor pressure measurements have been made with three halides of plutonium. Measurements with solid plutonium trifluoride from 1200°K to 1440°K give the vapor pressure-temperature relation $\log_{10} p_{mm} = 12.468 - 21{,}120/T$. Measurements with plutonium trifluoride from 1440°K to 1770°K give $\log_{10} p_{mm} = 11.237 - 19{,}400/T$. Measurements with solid plutonium trichloride from 850°K to 1007°K give $\log_{10} p_{mm} = 12.726 - 15{,}910/T$; with liquid trichloride from 1007°K to 1250°K give $\log_{10} p_{mm} = 9.509 - 12{,}590/T$. Measurements with solid plutonium tribromide from 800°K to 929°K give $\log_{10} p_{mm} = 13.386 - 15{,}280/T$; with liquid tribromide from 929°K to 1100°K give $\log_{10} p_{mm} = 10.321 - 12{,}360/T$.

CHEMISTRY (continued)

106 Compounds of uranium with the transition metals of the first long period. N. C. Baenziger, R. E. Rundle, A. S. Snow, and A. S. Wilson. AECD-2598, nd. Decl. May 25, 1949. 27p. Proposed for publication in Acta Cryst.

The transition elements Mn, Fe, Co, and Ni form several metal compounds with uranium, ranging in composition from U_6M to UM_5. In general, the compounds formed by these four metals with uranium are very similar. In the alloy systems of uranium with Mn, Fe, Co, and Ni, the following compounds occur: U_6Mn, U_6Fe, U_6Co and U_6Ni, all tetragonal and isostructural, and of a new structural type; UCo, a body-centered cubic compound, Z-8, with a unique structure; UNi, structure undetermined. UMn_2, UFe_2 and UCo_2, with the C-15 structure; UNi_2 with the C-14 structure; UNi_5 with the $PdBe_5$ structure, closely related to the C-15 structure. In addition, UCu_5 has a similar structure. Lattice constants and full structure determinations are reported for all compounds except UNi. For the latter, only powder data have been available and the structure is complex.

107 Elastic constants and sound velocities. III. The elastic constants of uranium. Henry L. Laquer. AECD-2606, nd. Decl. May 26, 1949. 29p.

Whereas static methods consist in a direct determination of the relation between stress and strain or possibly the cross-contractional ratio σ, all dynamic methods are based on the measurement of sound velocities. In this work, sound velocities were obtained by determining the natural resonance frequencies of cylindrical specimens of known length. The elastic constants of a number of well defined specimens of polycrystalline uranium metal have thus been determined by a dynamic method. Young's modulus was found to be 20.5×10^{11} dynes/cm^2 with a probable accuracy of 1 per cent. This is 10 to 20 per cent higher than values previously available in the project literature. The shear modulus was 8.34×10^{11} dynes/cm^2 with a probable accuracy of one half of 1 per cent. No other satisfactory values for the shear modulus have so far been available. The accuracy of these measurements is limited only by anisotropy and relatively large size of the individual crystallites in the available specimens. 17 references.

110 Composition, structure, and properties of iodide titanium. Bruce W. Gonser. Metal Progress 55, 346-7(1949) Mar.

Iodide titanium as deposited is coarsely crystalline. Deposits from a charge at 1020°F are finer grained but rough; low temperature runs are larger grained but each grain is smoother. Chemical and spectrographic analysis of impurities is given. The physical and mechanical properties of titanium are presented and discussed. The microstructures and tensile properties of iodide and magnesium-reduced titanium are given. The properties of titanium obtained by the Iodide Process as operated by Foote Mineral Company (Philadelphia, Pa.) are discussed by Felix B. Litton. A typical spectrographic analysis of Foote's iodide titanium produced in a metal bulb is given along with the average tensile properties of the sheet in the rolled or annealed condition.

MINERALOGY, METALLURGY, AND CERAMICS

111 Constitution of sintered and worked titanium-nickel alloys. J. R. Long. Metal Progress 55, 364-5(1949) Mar.

A tentative diagram for the binary titanium-nickel system is presented. Only the titanium rich portion of the system was investigated. The greatest response to heat treatment will be obtained in the titanium-nickel alloys containing 5 to 12% nickel. The hardness values of some phases in the as quenched and tempered condition are given. Several photomicrographs are included.

112 Engineering properties of sintered and rolled titanium. N. E. Promisel. Metal Progress 55, 354-5(1949) Mar.

A table is presented giving the strength, weight, and rigidity relations for titanium, steel, and 6 light alloys. The structural properties of these materials are discussed. Flexural fatigue tests on sheet 0.032 inch thick rolled from sintered compacts were run and a fatigue limit of 25000 psi was obtained. Spot welding tests were run and the results indicate that metallurgically sound spot welds with satisfactory shear properties may be obtained using stored energy equipment and fairly high electrode forces. Several diagrams are presented.

113 Fatigue and corrosion of sintered and rolled titanium. W. Lee Williams and William C. Stewart. Metal Progress 55, 351-3(1949) Mar.

The mechanical properties of titanium bar and sheet are presented. The material was hot rolled and finished with a 35-40% cold work. The excellent corrosion and erosion resistance of titanium to salt water are discussed. A table is given comparing the corrosion of titanium to aluminum and beryllium in oxygenated water at 500° F. The possible applications of titanium by the Navy are also discussed.

114 High-temperature properties of titanium alloy castings. P. H. Brace and W. J. Hurford. Metal Progress 55, 362-3(1949) Mar.

All of the high temperature tests were made on castings produced in the form of tensile specimens. Creep-rupture data and the results of tensile tests are presented in tabular form. The best yield strengths were noticed for titanium-chromium base alloys containing molybdenum and tungsten in a 4-to-1 atomic ratio.

115 Mechanical properties of wrought titanium alloys made by arc melting or by sintering. Howard C. Cross. Metal Progress 55, 356-8(1949) Mar.

Alloys of titanium and oxygen, nitrogen, or hydrogen were made at Battelle Memorial Institute, Columbus, Ohio, and investigated. Oxygen refines the structure of titanium. Nitrogen promotes the formation of needles of alpha-titanium. The structures of the hydrogen alloys are not much different from unalloyed titanium. The mechanical properties of the above mentioned alloys are presented and discussed.

Experiments were conducted with titanium alloys of chromium, molybdenum, tungsten, columbium, and tantalum. All alloys were prepared by the pressing and sintering methods of powder metallurgy, then hot rolled at 1650° F and furnace cooled. Graphs of the mechanical properties are shown and the results discussed.

116 Properties of binary sintered and rolled titanium alloys. E. I. Larsen, E. F. Swazy, L. S. Busch, and R. H. Freyer. Metal Progress 55, 359-61(1949) Mar.

The mechanical properties and electrical resistivity of titanium alloys in the hot rolled, cold rolled, and annealed conditions are presented and discussed. The titanium alloys investigated are hydrogen, beryllium, boron, aluminum, indium, carbon, silicon, zirconium, nitrogen, vanadium, oxygen, chromium, molybdenum, tungsten, manganese, iron, cobalt, and nickel. The data are presented in well organized tabular form.

MINERALOGY, METALLURGY, AND CERAMICS (continued)

117 Properties of melted and forged titanium-chromium alloys. D. J. McPherson and M. G. Fontana. Metal Progress 55, 366-7(1949) Mar.

Induction-melted and arc-melted titanium alloys are discussed. Most of the induction-melted alloys were hard and so brittle that they broke up during forging (Rockwell C-40). Exceptions were the ingots prepared in low-porosity beryllia and thoria crucibles. The hardness of these alloys was Rockwell C-25 and were readily forgeable at 1900° F. The titanium-chromium alloys which were prepared in the arc-furnace were readily forged between 1700 and 1900° F. The hardness values and microstructure of the alloys in the as-forged, annealed (furnace colled), and water-quenched condition are given. The corrosion resistance of the titanium-chromium alloys to various medium is discussed.

118 Properties of wrought commercially pure titanium prepared by arc melting and casting. C. I. Bradford, J. P. Catlin, and E. L. Wemple. Metal Progress 55, 348-50(1949) Mar.

The mechanical properties of titanium produced by the Remington Arms Company, Bridgeport, Connecticut, are presented. Much of the data was obtained by members of Battelle Memorial Institute, Columbus, Ohio. The tensile properties of forged bars over a considerable range of temperature are shown. At subzero temperatures the strength and modulus are high; torsion tests on forged bars indicate a modulus of elasticity in shear of 6,600,000 psi and a torsional shear strength of 101,300 psi; creep was negligible under a stress of 25,000 psi at 600° F, and at 16,000 psi, the average rate of creep was 0.000015% per hour over a period of 1125 hours.

The General Electric Company's River Works at West Lynn, Massachusetts, conducted preliminary welding experiments with Remington titanium. The experiments indicate that it can be spot welded, seam welded, and inert-arc welded to other pieces of titanium. Its corrosion resistance to salt water, temperature, and dilute acids is discussed along with the possible applications of the metal and its alloys.

119 Portable counter for geological research. O. J. Russell. Electronic Eng. 21, 173-4(1949) May.

A portable counter which has been developed for prospecting for radio-active uranium and thorium minerals, for general geological investigations, and as an ultra-sensitive detector of lost or mislaid radium, is described. The aforementioned general usage includes the identification of changes in strata by means of the investigation of the slight amount of residual activity present in most minerals. The apparatus, which consists essentially of a scaled-down version of a standard laboratory Geiger-Muller counter, is highly sensitive since a variation equivalent to 4% of the cosmic ray background can be detected by a three-minute count.

PHYSICS

120 Discussion on paper by F. C. Champion and R. R. Roy entitled "The scattering of fast β-particles through large angles by nitrogen nuclei." N. Feather and W. T. Davies. Proc. Phys. Soc. (London) 62A, 264(1949) Apr. 1 (See also Nuclear Science Abstract 2-691).

In this discussion Feather inquires concerning the possibility that the correction terms used by Champion and Roy (Proc. Phys. Soc. (London) 61A, 532(1948)) omit an effect of appreciable magnitude caused by energy-dependence. Recent unpublished, related experiments by Davies are noted by that author, in which eight cases of elastic scattering (electrons in air) through more than 50° were observed, although only 1 or 2 were to be expected; in addition scattering with an apparent energy loss exceeding 0.2 of the incident energy was found to occur with roughly the same frequency as elastic scattering for angles of scattering greater than 20°. The aforementioned value greatly exceeds that predicted by Mott (The Theory of Atomic Collisions by Mott and Massey. Oxford, University Press p. 272).

Champion and Roy reply to the preceding remarks by noting: (1) The accuracy of the experiments which Feather questions is estimated as $\pm 20\%$ and it is not believed that the correction terms used omit

PHYSICS (continued)

any serious effects arising from energy-dependence; (2) The energy just below 1 Mev investigated by the authors (i.e., Champion and Roy) is considerably less than that used by Davies and it is possible that inelastic collision may increase rapidly with energy above 1 Mev.

121 Cloud-chamber study of mesons stopping in aluminum foils. R. L. Cool, E. C. Fowler, J. C. Street, W. B. Fowler, and R. D. Sard. Phys. Rev. 75, 1275-6(1949) Apr. 15 (Letter to the editor).

A study has been made at an elevation of 3410 m of mesons stopping in 0.02 cm Al foils mounted in a large Wilson cloud chamber. A crossed counter arrangement was used which was equivalent to using 16 telescopes. In 12,100 pairs of photographs, 10 cases of mesons stopping in the Al foils were identified. Three of these show a light track appearing to originate at the stopping point, one shows a heavy track appearing to originate there, and 6 show no associated ionizing particle. Possible interpretations of these results are noted.

122 Cosmic-ray induced nuclear stars at high altitudes. P. Freier, E. P. Ney, and F. Oppenheimer. Phys. Rev. 75, 1451-2(1949) May 1 (Letter to the editor).

Tabulated results are given on the rate of nuclear star formation in Ilford C2 emulsions at altitudes up to 93,000 ft. The results obtained clearly show the transition effect for small stars in the atmosphere. Data on small stacks (3/4 in. × 2 in. × 4 in.) and on large stacks (4 in. × 4 in. × 10 in.) are shown. The following observations are noted: (1) the rate of small star production at high altitudes is only about 1/4 the rate at intermediate altitudes; (2) the rate of small star production in the large stack at high altitude (where it spent most time) is approximately equal to the rate of small star production in the "free atmosphere" (small stack) at intermediate altitudes; (3) the rate of large star production ($\geq$10 prongs) is not appreciably affected by thickness of matter up to 50 g/cm^2; (4) the rate of small star production in the stack saturates at a thickness of glass of about 18 g/cm^2; (5) the ratio of slow meson σ-stars to all stars is roughly five times greater in the dense matter of the large stack than in the free atmosphere, even under the same total matter. The results are discussed and it is concluded that the data are consistent with the conclusion that the primaries themselves generate a negligible number of small stars since the relatively few small stars made at high altitudes can be accounted for by the fraction of the primary radiation that, because of its obliquity, has traversed at least 60 g/cm^2. Assuming a proton flux of 0.12/cm^2/sec/ster., the cross section for star production is estimated as 0.15×10^{24} cm^2. It is noted that the mechanism of star production may well involve the production within the nucleus of a shower of mesons and the subsequent interaction of these mesons with the other nucleons. A possible explanation offered for the rapid saturation observed for the small star transition effect is that a very rapid decrease of the cross section for star production occurs with decreasing energy.

123 Cosmic rays. George W. Gray. Sci. Am. 180, 29-39(1949) Mar.

Our present-day knowledge of the origin and composition of cosmic rays is reviewed. The various components of the radiation, and particles which have been identified are described and numerous cloud chamber photographs showing typical tracks for various of the aforementioned particles are shown and discussed.

124 Formation of cosmic ray showers under thick lead filters at various altitudes. L. V. Kurnosova and B. A. Shulyak. Doklady Akad. Nauk S.S.S.R. 61, 1023-6(1948) Aug. 21 (in Russian).

"Special showers" observed by the members of several expeditions into the Pamir mountains are generated under thick lead filters and increase in numbers more rapidly than the hard component of the cosmic radiation (Veksler, et al. Zhur. Eksptl. i Teoret. Fiz. 17, 1026(1947); Zhdanov and Lubimov, Doklady Akad. Nauk S.S.S.R. 55, 119(1947)). In the present article an account is given of experiments made with the aid of counters placed inside lead boxes (13 cm roof, 7 or 14 cm walls.) The study of the altitude effect (900, 3860, and 4700 m), of the absorption of the generating component in various materials (Pb and Fe), and of the coincidences registered inside and outside the filtering box showed

PHYSICS (continued)

(1) that the showers are independent of the δ-showers from mesons; (2) that the correlated discharges outside the filter box are produced by particles coming from the latter's walls; (3) that the showers consist both of a penetrating and a soft component; (4) that the generating particles form a fraction (amounting to several per cent) of the hard component of the cosmic radiation; (5) that they are probably primary protons producing short-lived mesons which disintegrate into electrons and photons of the soft part of the showers.

125 Neutrons in the extensive air showers of the cosmic radiation. Vanna Cocconi Tongiorgi. Phys. Rev. 75, 1532-40(1949) May 15 (See also Nuclear Science Abstract 2-1566).

Neutrons associated with extensive air showers have been studied by recording delayed coincidences among Geiger-Müller counters and proportional BF_3 counters. The experiments have been performed at 260, 3260, and 4300 m above sea level. It has been shown that in the extensive showers both neutrons of moderate energies and radiations capable of producing such neutrons are present. The number of neutrons and neutron-producers in showers of different sizes is roughly proportional to the number of the electrons. The neutron-producers cannot be, at least in a large fraction, either electrons, or photons, or μ-mesons. Nuclear interactions induced by fast neutrons and protons are consequently thought to give the main contribution to the neutron production observed. The total neutron-producing-radiation is of the order of 2 to 3% of the electronic component of the showers at 3260 m. Its altitude variation is consistent with the assumption that nucleons constitute its main component. The multiplicity of the neutron production in lead is very high: ~60 neutrons of energies between 2 and 15 Mev are produced at a time on the average.

126 Nuclear disintegrations in photographic plates exposed to cosmic rays under lead absorbers. E. P. George and A. C. Jason. Proc. Phys. Soc. (London) 62A, 243-252(1949) Apr. 1.

Ilford Nuclear Research photographic plates have been exposed at an altitude of 3,457 m under lead screen of thicknesses varying up to 28 cm. The intensity of the stars, and its variation with the number of tracks forming them, has been recorded for each thickness of absorber. The absorption curve of the star intensity shows that the range in lead of the radiation causing the stars is 310 ± 20 gm/cm^2. The size distribution is apparently the same under all absorbers. Intensity and size distribution have also been recorded in similar plates exposed at sea level. The size distribution is again the same as that found for the high altitude plates, but the range in air of the primaries is 150 ± 7 gm/cm^2. These results are consistent with the generally accepted view that most of the stars produced are caused by neutrons. 27 references.

127 Photons in extensive cosmic-ray-showers. J. Clay. Proc. Koninkl. Nederland. Akad. Wetenschap. 52, 450-6(1949) Apr.

The results are given of 6 and 8-fold coincidence measurements of extensive showers with layers of lead above and between the counters, by means of which the absorption of the electrons and the production of electrons in the showers could be estimated. The data indicate the presence of many energetic photons, the number increasing with the density of the shower particles. By measuring 4- and 6-fold coincidences for surfaces of relative sizes from 1 to 6 the value of the coefficient S in the frequency-density relation $I = I_0 \cdot N^{-S}$ could be found and it is concluded that S is not constant but varies from S = 3.0 for very small densities to S = 1.5 for high densities. This result is in agreement with the frequency-density relationship for bursts.

128 Physical significance of the index of repartition of density in auger showers. Jean Daudin. J. phys. radium 10, 65-72(1949) Mar. (in French).

The repartition law for Auger showers which faciliates numerous calculations is only an approximation. Physical factors such as the density, geometry and the altitude, which cause the exponent of this law to vary are examined from the experimental point of view. The rapid diminution of the dense

PHYSICS (continued)

showers of the atmosphere with altitude, it is noted, is not in agreement with the predictions of the cascade theory. It is suggested that the lowering in energy calls forth mechanism other than "stopping" radiation and materialization at high energies. The cascades, whatever their mechanism, possess certain general properties, such as the fact that the energy spectrum under general conditions is conservative.

129 Production of π-mesons in nucleon-nucleon collisions. L. L. Foldy and R. E. Marshak. Phys. Rev. 75, 1493-9(1949) May 15.

The cross section for the production of π-mesons in nucleon-nucleon collisions is calculated at energies just above the threshold. The process is treated in complete analogy with photonic bremsstrahlung: the π-meson field is coupled to the nucleon and an empirical potential between the two nucleons ensures momentum and energy conservation. The nuclear potential is taken from the Berkeley experiments on neutron-proton scattering at 90 Mev (private communication). In this treatment the symmetric scalar theory yields zero cross section if the recoil of the nucleons is neglected. The symmetric pseudoscalar theory (with pseudovector coupling) leads to results which are given in tabular form. The cross section obtained is several orders of magnitude smaller than the cross section obtained by Morette and Peng (Proc. Roy. Irish Acad. 51A, 217(1948)) on the basis of a thoroughgoing field-theoretic approach.

130 Theoretical analysis of ionization chamber data on large air showers. John M. Blatt. Phys. Rev. 75, 1584-98(1949) May 15.

The decoherence curve of large air showers was analyzed under the simplifying assumption of a constant lateral structure function for all air showers. The following results were obtained: (1) Contrary to statements found in the literature, ordinary shower theory leads one to expect a rise in the decoherence curve at distances much less than the characteristic lateral distance r_1. (2) The theoretical decoherence curve calculated under the assumption of a constant structure function rises more sharply near the origin than the experimental points. This indicates that the effective structure function is less peaked than the one used. (3) The dependence of the structure function upon the age of the shower tends to lessen this discrepancy. However, quantitative estimates make it appear doubtful that agreement between theory and experiment can be obtained without assuming a rather high multiplicity of the event which starts the shower.

131 Remote control for continuous liquid extractors. Remsen T. Schenck. AECD-2610, nd. Decl. May 24, 1949. 8p. For publication in NNES.

Procedures for the separation of ions by continuous or semicontinuous extraction of aqueous solutions of the salts with immiscible solvents involve a series of unique problems of control particularly if part of the material in solution is a highly radioactive species. An electronic device has therefore been developed for indication at a distance and simultaneous automatic correction of changes in density, temperature, and interface level of polyphase solutions.

132 Input impedance and gain of grounded-grid amplifier. P. E. Ohmart. AECU-230, Mar. 24, 1949. 7p.

The input impedance and gain of a grounded-grid amplifier has been computed with the use of an equivalent circuit. The effect of the plate load on the input impedance is considered theoretically. It is shown that the input impedance of a grounded-grid amplifier can be changed to match a transmission line by varying the resistance and the reactance of the plate load.

133 Measured properties of strong "unipotential" electron lenses. G. Liebmann. Proc. Phys. Soc. (London) 62B, 213-28(1949) Apr. 1.

The Hartmann test (Z. Instrumentenk. 24, 1(1904)) and the "knife-edge" method (Boersch, Z. Tech. Physik 20, 346(1939); Dosse, Z. Physik 117, 722(1941)) for the determination of lens constants are described as applied to the investigation of electrostatic "unipotential" lenses. The results of measurements on a number of such lenses are presented graphically. It is shown that the curvature of the

PHYSICS (continued)

principal surfaces plays an important part and that it is, therefore, necessary to distinguish between longitudinal spherical aberration and difference of zonal focal lengths. Up to about half the lens diameter, primary spherical aberration, only, is noticeable in most cases. The dimensionless spherical aberration constant S can be approximately represented, over a wide range of modifications of lens design or lens potentials, by the formula $S = K_1(f/D)^2$, f being the focal length and D the internal diameter of the center electrode of the lens. K_1 is a constant of the order of 10 for the lenses investigated without stops limiting the axial length of the field, and of the order of 20 for lenses incorporating such stops. In the case of one specially constructed lens, good agreement is found with calculations by Ramberg (J. Applied Phys. 13, 582(1942)). In an experimental unipotential lens from which the diverging parts of the electrostatic field were removed, the spherical aberration is as low as in magnetic lenses of comparable dimensions.

134 Scientific and industrial glass blowing and laboratory techniques. W. E. Barr and Victor J. Anhorn. Pittsburgh Instruments Publ. 1949. 380p.

In addition to instructions on glass blowing, information of the properties of various glasses, and on the various glass-to-metal seal-techniques, some of the advanced techniques necessary to the production of high vacua are discussed. The construction, calibration, and uses of various types of vacuum pumps and gages are treated in detail.

135 A new stable isotope of platinum. Henry E. Duckworth, Robert F. Black, and Richard F. Woodcock. AECU-220, Mar. 18, 1949. 7p.

An ion source and double-focusing spectrograph similar to that used by Dempster in the first successful mass analysis of platinum (Nature 135, 993(1935)) was employed in a search for Pt^{190}. A faint line appeared at mass 190; the authors advance several arguments to support the conclusion that this line is due to Pt^{190} rather than to an impurity. An average value of 0.006% was obtained for its abundance. An article based on this document has appeared in Phys. Rev. 75, 1438-9(1949) May 1.

136 The AEC's isotopes. Sci. Am. 180, 17(1949) Apr.

Tables are given of the isotopes available for research through the Atomic Energy Commission. (These may be obtained at no cost by qualified cancer researchers.) In addition to the radioactive isotopes listed, the stable isotopes available are also noted. The table of the radioactive isotopes lists the characteristic radiations, half-lives, and some typical applications of the various isotopes. The latter are given with particular reference to biological applications.

139 Separation of isotopes in small quantities. W. Walcher. FIAT Review of German Science 1939-1946, Nuclear Physics and Cosmic Rays - Part 2, 94-107(1948) (in German)

Five methods of small-quantity separation of isotopes were studied in Germany in 1939-1946. For his mass-spectrographic work, Walcher (Z. Physik 122, 62(1944)) constructed an ion source in which a stream of atoms (vapor produced in a furnace) is bombarded transversely by a focused electron stream;

PHYSICS (continued)

the ions formed are gathered by an electrostatic lens into a parallel or converging stream. For silver, an accelerating potential difference of 200 volts and an electron current intensity of 100 ma produced on an ion current of 30 μa; the mass-spectrographic separation yielded 5×10^{-7} mol/day of each Ag^{107} and Ag^{109}, 99% pure. Thallium isotopes Tl^{203} and Tl^{205}, separated by this method on an aluminum foil (70 μg Th in 20 hrs) were investigated with an interference spectrograph: the previous tentative attribution of the hyperfine structure of thallium to its isotopes was confirmed. Ewald (unpublished research report) devised a "magnetic isotope separator" in which ions from a cylinder-shaped source are projected radially into a surrounding magnetic field; the radii of the ensuing circular trajectories depend on the ion masses, so that heavy particles can be caught on an external concentric collector, while lighter particles return to the source. This device was not studied experimentally. Bagge (two unpublished research reports, 1942 and 1943) constructed an "isotope sluice," in which an atom stream is cut successively by two rotating perforated discs, the slots in the second disc being wider than those in the first one; from the mixture of isotopes caught between the two discs, the faster moving atoms will pass through the second disc in relatively larger quantities than the slower moving ones. By this method 0.3 mg/hr enriched silver-isotope mixture was collected in which $Ag^{107} : Ag^{105} = 1.13 \pm 0.01$, while in natural silver this ratio is 1.080 ± 0.002. Klemm (unpublished research record and Z. physik. Chem. 193A, 29(1943)) separates isotopes by using diffusion in solid salts; two short cylinders of compressed Ag_2S and Cu_2S powders are placed end to end and heated at 450°C for 12 hours in nitrogen; the diffusion coefficient of both Ag^+ and Cu^+ at this temperature being equal to 1.1 cm^2/day, isotope enriched zones can be obtained. Klemm (Naturwissenschaften 32, 69(1944); Z. Physik 123, 10(1944)) has developed also a method of electrolysis in solid salts: a glass tube (4 mm ID) is filled with compressed AgI, a block of AgI (25 mm × 30 mm D) is interposed between one end of the tube and the Ag cathode (30 mm D); at the other end, a movable carbon anode (4 mm D) compresses the AgI column inside the tube; the electrolysis, under 250 ma, takes place at 230°C (melting point of AgI is 557°C), and after 20 hours the length of the AgI column is reduced from 730 mm to 80 mm; the mass-spectrographic analysis of the AgI block at the cathode shows zones of enrichment in Ag isotopes.

140 Mass spectrometry and spectrography. Étienne Roth. J. phys. radium 10, 14D-16D(1949) Mar. (in French).

A resume of some of the principal applications of mass spectrometry and spectrography is given. (A bibliography for the years 1947 and 1948 (up to September 15, 1948), which has been made as complete as possible, will appear in the April issue.). Following a discussion of the principles and general theory of the instruments used, various related factors are noted. The use of mass spectrometers to measure isotopic abundances and to separate stable isotopes is described.

141 A time-of-flight mass spectrometer with varying field. J. A. Hipple and H. A. Thomas. Phys. Rev. 75, 1616(1949) May 15 (Letter to the editor).

A modification of the time-of-flight mass spectrometer recently proposed by Goudsmit (Phys. Rev. 74, 622(1948)) is discussed. By changing the variation in E, the uniform electric field, with time, the transit time could be increased. The chief difficulties of this method of long ion path and the lack of focusing in the direction of the magnetic field are noted; however, the possibility of detecting some of the ions after a fairly long transit time warrants some exploratory experiments as does the possibility of the incorporation of weak axial focusing if E is kept at zero for an appreciable portion of the time. Another possibility would be to decrease E to zero, allowing the ions to spin at the maximum y-displacement of the moving coordinate system and subsequently displace them in a helical path by a weak electrostatic field in the direction of the magnetic field. This would give perfect focusing for all masses and using the proton moment to measure the value of the magnetic field, this device could be used to determine e/m with good accuracy since all measurements would involve only time. The construction of such an apparatus is now in progress.

PHYSICS (continued)

142 Kinetic energy release in fission of U^{238}, U^{235}, Th^{232}, and Bi^{209} by high energy neutrons. J. Jungerman and S. C. Wright. AECD-2594, Feb. 24, 1949. Decl. May 19, 1949.

The ionization produced by single fission fragments are observed in an ionization chamber using electron collection. If fission is induced by 90 Mev neutrons, the distribution of kinetic energy of the fission fragments versus the number of fragments is found to have a single peak in contrast to the double-peaked curve corresponding to the fission made by thermal neutrons. Fission induced by 45 Mev neutrons gives a distribution in which two peaks appear. The dip between the two peaks is about 20 per cent of the height of the peaks. The mean kinetic energy is found to be 80 ± 2 Mev for U^{238}, 83 ± 1.5 Mev for U^{235}, 82 ± 2 Mev for Th^{232}, and 71 ± 2 Mev for Bi^{209} in the case of fission produced by 90 Mev neutrons. The mean kinetic energy is 79 ± 3 Mev for U^{238} and 84 ± 3 Mev for Th^{232} if 45 Mev neutrons are used. The most probable kinetic energy of the fragment is 83 Mev for U^{238}, 80 Mev for U^{235}, 83 Mev for Th^{232}, and 75 Mev for Bi^{209} in the case of fission produced by 90 Mev neutrons. The bearing of these observations on the mechanism of fission is discussed.

143 Determination of the phase of scattering of neutrons and of incoherent residual scattering cross sections. P. J. Bendt and I. W. Ruderman. AECD-2615, Apr. 29, 1949. 1p. Proposed for publication in Bull. Am. Phys. Soc.

This document is in abstract form and is reproduced below in its entirety.

The phase in which neutrons are scattered by various elements, and the coherent scattering cross sections of these elements, have up to now been obtained principally by measurements of the intensities of Bragg reflections from suitable crystals. For such measurements a crystal spectrometer and an intense neutron source such as a pile are needed. We wish to point out that similar information can be obtained more readily and directly from transmission experiments. In a typical experiment, the Columbia neutron velocity spectrometer was used to obtain transmission curves for two pure elements and for a substitutional solid solution of the two, for neutron wavelengths up to and beyond the cut-off wavelength for Bragg reflections, λ_c. The cross section vs neutron wavelength curves in the region beyond λ_c, when extrapolated to zero wavelength, give directly the residual incoherent scattering cross sections, σ_r. The temperature-dependent part of σ_r may be determined by repeating the transmission experiments at liquid nitrogen temperature. The value of σ_r for the solid solution shows whether the two constituent elements scatter neutrons in the same or in opposite phases, and gives information about order-disorder in the alloy. The Cu-Ni, Mn-Ni, and Mn-Fe systems are now being studied.

146 An interpretation of the resonance scattering of neutrons by cobalt in terms of the Breit-Wigner equation. F. G. P. Seidl. Phys. Rev. 75, 1508-18(1949) May 15.

The neutron transmission of a Co foil (8.67 mg/cm^2) was measured for epi-thermal pile neutrons which were filtered through various thicknesses of B^{10}. The detector consisted of an annular BF_3 counter which was set up to count only neutrons scattered by a second Co foil (9.55 mg/cm^2). The

PHYSICS (continued)

counter sensitivity as a function of neutron energy was studied. Effective total cross sections of 3100 b (barns) and over were calculated from observed transmissions. By means of B^{10} absorption, a resonance was located at 108 ± 10 ev and this was associated with resonance scattering of the neutrons. The total resonance cross section σ_0 was estimated to be 12,500 ± 1250 b and the magnitude of the resonance scattering, expressed by $\gamma \cdot \sigma_s(E_r)$, was estimated to be ~45,000 ev-b, here γ denotes the total level width and $\sigma_s(E_r)$ denotes the elastic scattering cross section at resonance. The neutron transmission was calculated from the single-level Breit-Wigner equation for the case where scattering is the predominant process. This equation was written in a conventional form involving, besides energy dependence, the parameters Γ, R, and j; where the neutron width is $\Gamma(E/E_r)^{1/2}$, $4\pi R^2$ represents the scattering from the surface of the initial nucleus, and j is the spin quantum number of the compound nucleus. Calculated transmissions agreed with experimental transmissions in two instances: (1) Γ = 2.0 ± 0.1 ev, R = +0.93 × 10^{-12} cm, j = 4, and (2) Γ = 5.0 ± 0.5 ev, R = +0.97 × 10^{-12} cm, j = 3. However, the value σ_0 = 12,500 ± 1250 b is consistent only with j = 4. A negative R will mean that the minimum of the "dispersion" curve $\sigma_s(E)$ vs E occurs above the resonance energy E_r and such was found to be inconsistent with the data. Similar scattering resonance takes place in manganese, $E_r \approx 300$ ev; here σ_0 lies between 4000 and 5000 b and $\Gamma \sim 10$ ev.

147 Neutron diffraction. G. E. Bacon and J. Thewlis. Proc. Roy. Soc. (London) 196A, 50-64(1949) Feb. 22.

The problem of neutron diffraction by crystals is treated by analogy with x-ray diffraction; the following are considered: the perfect crystal, the mosaic crystal and the powdered block. The first part of the paper deals with a comparison between x-rays and neutron diffraction and it is shown that quantitatively the two are similar, apart from the case of the thick mosaic crystal where the very low values which are usually found for the true absorption of neutrons result in the integrated reflection being largely independent of structure factor under practical conditions. The second part deals with the practical problem of diffracting the collimated beam of thermal neutrons from an atomic pile. Again, perfect and mosaic crystals are considered and it is also shown that the powder method, which it is desirable to use when structure factors are to be determined, will be feasible if the number of pile neutrons which hit the monochromatizing crystal is greater than 10^5 per sec.

148 Neutron diffraction by gases. N. Z. Alcock and D. G. Hurst. Phys. Rev. 75, 1609-10(1949) May 15 (Letter to the editor).

The intensity of neutrons scattered from the gases carbon dioxide and oxygen has been measured in the angular range 5° to 90° using a modified crystal spectrometer, near a heavy water pile, to select neutrons of 0.07-ev energy. The gases studied were contained in a steel vessel at room temperature and approximately 60 atmospheres pressure. A schematic diagram of the apparatus used and curves of the relative scattered-neutron intensity as a function of scattering angle are shown. The latter are compared with simple theoretical curves for both gases. Owing to the extensive computations involved, the quantum-mechanically correct method of calculating scattering values was not attempted and the theoretical curves were obtained by a semiclassical calculation in which the neutron was represented by a wave and the molecule by a rigid system of point-scatterers. Elastic scattering was assumed and no correction was applied for paramagnetism although small corrections were applied for the Doppler effect and for conversion to the laboratory system of coordinates. The good agreement obtained in the case of oxygen leads to the conclusion that the exact formulas condense, to a close approximation, to the semi-classical result. However, it is noted that carbon dioxide shows a marked deficiency in intensity at small angles. Intermolecular interference is suggested as a possible cause and it is noted that in the experiments the carbon dioxide used was near the liquid phase.

PHYSICS (continued)

149 Reactions induced by slow neutron irradiation of europium. Richard J. Hayden, John H. Reynolds, and Mark G. Inghram. Phys. Rev. 75, 1500-7(1949) May 15.

A sample of europium which had been subjected to slow neutron irradiation was analyzed using mass spectrometric techniques. By using a modified isotopic dilution technique, i.e., adding a standard containing known relative abundances of normal samarium, europium, and gadolinium, the complete chemical and isotopic analysis of the irradiated sample was obtained. Combining this nuclide composition and certain radioactivity measurements the thermal neutron cross sections, half-lives, and branching ratios of five of the europium isotopes were calculated. The results were σ_{151} = 5200 barns, σ_{152} = 3200 barns, σ_{153} = 240 barns, σ_{154} = 880 barns, σ_{155} = 7900 barns, $T_{1/2}(152)$ = 5.3 years, $T_{1/2}(154)$ = 5.4 years, $T_{1/2}(155)$ = 1.7 years, K/β^- ratio for 9.2-hour Eu^{152} = 0.22, K/β^- ratio for 5.3-year Eu^{152} = 2.8, and K/β^- ratio for 5.4-year $Eu^{154} < 0.05$. All these results are believed to be good to ± 15%.

150 The effects of nuclear stability on the formation of the chemical elements. J. S. Smart. Phys. Rev. 75, 1379-84(1949) May 1.

Nuclear stability considerations are applied to the neutron capture theory of the formation of the chemical elements. It is shown that the matter density during the time of formation must have remained with the limits 10^{-1} g/cm^3 and 10^{-11} g/cm^3. The nuclei were probably formed with some neutron excess so that both neutron capture and β-decay were effective in determining relative abundances. The chain of formation followed a path such that the β-decay and capture probabilities were approximately equal. The abundance of nuclei of even atomic weight over those of odd atomic weight can be explained from the general features of the nuclear energy surface, regardless of the neutron excess at the instant of formation.

151 The magnetic moment of the proton. H. Taub and P. Kusch. Phys. Rev. 75, 1481-92(1949) May 15.

The molecular beam magnetic resonance method has been employed to measure the frequency corresponding to a reorientation of the proton in the molecule NaOH and the frequency corresponding to a transition between certain of the hfs levels of the ground state of both the atoms Cs^{133} and In^{115} in the same magnetic field. From these data the ratios of the g factor of the proton g_H, to the g factor of total electronic angular momentum, g_J, $g_H/g_J(Cs, {}^2S_{1/2}) = 15.1911 \times 10^{-4}$ and $g_H/g_J(In, {}^2P_{1/2}) = 45.6877 \times 10^{-4}$ are calculated. From a knowledge of the ratios $g_J(Cs^{133})/g_J(Na^{23})$ and $g_J(In^{115})/g_J(Na^{23})$ two entirely independent values of the ratio $g_H/g_J(Na^{23})$ have been obtained: (1) from indium $g_H/g_J(Na) = 15.1923 \times 10^{-4}$ and, 2) from caesium $g_H/g_J(Na) = 15.1931 \times 10^{-4}$. From the known value of $g_s/g_l = 2(1.00116)$, where g_s and g_l are, respectively, the g factors of electron spin and of orbital angular momentum, and on the basis of the assumptions that $g_s = g_J$ and that $g_l = 1$, it is found that $g_H = 30.4206 \times 10^{-4} \pm 0.005\%$. Including a small diamagnetic correction, the magnetic moment of the proton, μ_H, is then determined as $\mu_H = (15.2106 \times 10^{-4} \pm 0.005\%)$ Bohr magneton.

152 Magnetic moment of the proton. Natl. Bur. Standards (U. S.) Tech. News Bull. 33, 57-60(1949) May (See also Nuclear Science Abstract 2-1979).

The magnetic moment of the proton has been accurately determined by Thomas, Driscoll, and Hipple to about one part in 6,000, as $\mu = (1.4100 \pm 0.0003) \times 10^{-23}$ gauss-cm^3. A new value for e/m of $(1.75878 \pm 0.00016) \times 10^7$ emu/g has also been obtained using the results of the aforementioned investigations and data obtained by Taub and Kusch. It is noted that this new measurement of the proton's gyromagnetic ratio provides an accurate secondary standard for magnetic fields. A description of the experimental method used, in which nuclear resonance techniques were employed, is given.

PHYSICS (continued)

154 Yields of manganese in spallation reactions. Normal A. Bonner and William C. Orr. AECU-223, Apr. 19, 1949. 5p.

In order to determine the yield of Mn in spallation reactions a new approach was used which consisted of bombarding all elements from atomic number 21(Cr) to 38(Sr) excepting only Rb and Kr with 190-Mev deuterons in the 184-inch cyclotron. The manganese was separated chemically and the yields of 5.8-day Mn^{52} and 2.59-hour Mn^{56} determined. The results are graphically presented.

155 Beryllium-proton reactions and scattering. R. G. Thomas, S. Rubin, W. A. Fowler, and C. C. Lauritsen. Phys. Rev. 75, 1612-13(1949) May 15 (Letter to the editor).

The results of previous work of various investigators of beryllium-proton reactions and scattering are summarized in the form of two sets of curves, one of the cross section for scattering of protons by beryllium at 138° and the other of the cross section for the $Be^9(p,d)Be^8$ and $Be^9(p,\alpha)Li^6$ reactions at 138°. The latter were measured for bombarding energies from 250 to 1300 Kev, using a high resolution double-focusing 180° magnetic spectrograph for reaction particle analysis (Phys. Rev. 74, 1564(1948)). Experimental details are given and the proton curves are compared with those for deuterons and α-particles. The proton scattering cross section shows prominent anomalies near 998 and 1087 Kev, where marked resonance occurs in the cross section for the $Be^9(p\gamma)B^{10}$ reaction. A careful study of the α- and deuteron yield near 1087 Kev was made with no indication of anomalous results similar to that in the elastic scattering. If an assignment of J = 0 and even parity is made for the state at 1087 Kev in B^{10}, then a strict selection rule forbidding α- or deuteron emission from this state follows. This is consistent with the known fact that this state does not radiate (Revs. Modern Phys. 20, 236(1948)) to the ground state of B^{10} and with the recent assignment of J = 3 to the ground state since an octopole transition is then involved. The observed width is consistent with p-wave proton capture, formation of the state by s-wave capture not being possible since Be^9 has a spin of 3/2.

156 On the transmutation of elementary particles. Alexandre Proca. Compt. rend. 228, 298-300(1949) Jan. 24 (in French).

Transmutations between elementary particles are considered as transitions between distinct stationary states of a single system, i.e., the various particles constitute the various states which are characterized by quantum numbers of mass and of spin. The spin is considered first and an expression is obtained for the wave equation of a free particle of given rest mass having a spin which is permitted to take only certain values. The results obtained are discussed and compared with those obtained by Fierz (Helv. Phys. Acta 12, 1(1939)).

157 Transport phenomena in a completely ionized gas in presence of a magnetic field. Rolf Landshoff. AECD-2590, nd. Decl. May 13, 1949. 14p. Proposed for publication in Phys. Rev.

The free electrons which are present in an ionized gas will cause it to conduct electricity and heat quite easily. This will be reduced in the presence of a magnetic field because the electrons go in circles, which limits their effective mean-free-path. A theory of the behavior can be given by means of the kinetic theory of gases which describes the gas by giving the distribution in space and velocity for each kind of particle. These distribution functions have to obey a set of equations which are due to Boltzmann. A simplified treatment which is based on the assumption that the interaction between electrons is small compared to the interaction between electrons and the nuclei can be carried out with relatively little effort. In this case the conduction coefficients can be expressed as integrals which contain the collision

PHYSICS (continued)

frequency of the electron. In a completely ionized gas, one deals with Rutherford scattering and a mean-free-path which goes as the fourth power of the velocity. In view of the possible application of this theory to star atmospheres which contain a large percentage of hydrogen, it was not considered to be a safe approximation to neglect the interaction between electrons, since it is of the same order of magnitude as the interaction between electrons and protons. This makes it necessary to go through the much more elaborate theory, which is the subject of this paper. The paper is divided into the following sections: Boltzmann's equation, form of solution, the case of negligible electron-electron scattering, treatment of divergent integrals, and calculation of matrix elements.

158 A possible experimental verification of the statistics of He^3. D. ter Haar. Phys. Rev. 75, 1444-5(1949) May 1 (Letter to the editor).

The possibility of determining the type of statistics obeyed by He^3 by means of measurements of the second virial coefficient, B, is noted and the similar calculations made for He^4 are discussed. The influence of the smaller mass of He^3 on the $BT^{3/2}$ curve has been investigated by calculating values of B as a function of T (temperature) for low temperatures, using the hard sphere model (Uhlenbeck and Beth, Physica 3, 729(1936)). Using the same radius for both He^3 and He^4, and assuming Bose-Einstein statistics, it was found that the maximum of the curve for mass 3 was shifted to a temperature about one-third higher than that in the case of mass 4. Further calculations of this type, using the correct force field, are in progress to determine whether or not He^3 really obeys the Fermi-Dirac statistics.

159 Erratum: second-order stark effect of methyl chloride. Robert Karplus and A. Harry Sharbaugh. Phys. Rev. 75, 1449(1949) May 1 (Letter to the editor) (See also Nuclear Science Abstract 2-1724).

An error in obtaining the field strengths in a previous article by the authors (Phys. Rev. 75, 889 (1949)) has been corrected, changing the value of the dipole moment for methyl chloride to $\mu_0 = 1.87 \pm 0.03$ Debye units, which is in agreement with 1.86D given by Smyth (Dielectric Constant and Molecular Structure, New York, 1931).

160 Visual efficiency of a phosphor bombarded by plutonium alpha particles. Ernest Wakefield. AECD-2597, Nov. 15, 1948. Decl. May 23, 1949.

A series of phosphor samples of zinc beryllium silicate and magnesium tungstate were exposed to alpha particles from a 9.9 mg sample of plutonium dioxide of approximately 2.0 mg/cm^2 thickness. The phosphor samples were mounted about 60×10^{-3} cm from the PuO_2 sample. Brightness readings were made by three different observers using a Taylor Type A Brightness Meter. To determine the uniformity of the PuO_2 deposit a Pressure Seal Mica Window Counter was used to scan the surface; in addition a densitometer check was made of an exposed photographic film. Assuming a uniform layer of PuO_2, calculations were made to determine the power dissipation in the phosphor as a function of thickness in the phosphor. The light absorption of the phosphor was calculated from data given by Kallman (Report PB 860043, Dept of Commerce, Washington, D. C.) assuming a particular phosphor thickness. The visual efficiency for the phosphor studied was found to be about 3.35 lumens per watt.

161 Decay of scintillations in calcium fluoride crystals. W. J. MacIntyre. Phys. Rev. 75, 1439-40(1949) May 1 (Letter to the editor).

The decay of the scintillations of a calcium fluoride crystal has been measured by a delayed coincidence method in which data on the scintillations of a crystal are obtained as a function of time. This method is based on a delayed coincidence counting of the pulse of a proportional counter activated by a β-particle with the pulse of an electron multiplier tube detecting the scintillation from the crystal activated by the same particle. A beam of β-particles from P^{32} which penetrated the proportional counter and impinged on the scintillation phosphor was utilized. Curves are shown of the coincidence rate as a function of the time delay for the calcium fluoride at dry ice temperatures; these are compared with curves for napthalene. Similar curves for calcium fluoride are also compared with data taken at room temperature and at dry ice temperature. From the data obtained the half-life of the phosphor investigated was found to lie in the range of $14\text{-}16 \times 10^{-8}$ sec.

PHYSICS (continued)

162 Experiments with the delayed coincidence method, including a search for short-lived nuclear isomers. D. E. Bunyan, A. Lundby, and D. Walker. Proc. Phys. Soc. (London) 62A, 253-63(1949) Apr. 1.

The delayed coincidence method has been studied in some detail and employed in a search for short-lived isomers in the product nuclei of β-emitters. The influence of counter time-lag fluctuations, which determine the short half-life limit in this method, is discussed in relation to the "differential" procedure for recording the delayed coincidences. It is shown that the time lags exhibited by a Geiger-Müller counter are distributed approximately according to a Gaussian law. A differential delayed coincidence recorder has been constructed in which the overall time-lags in the two input channels due to "rise-time" effects have been stabilized. At the coincidence stage of this recorder the quadratic mean deviation in the time-lag difference between the two channels due to "rise-time" effects has been kept as low as $\sim 5 \times 10^{-9}$ sec. Details are given of the experimental procedure used in searching for short-lived isomers. The range of possible half-lives most thoroughly investigated extends from about 3×10^{-7} sec to about 10^{-3} sec for isomeric transitions giving conversion electron energies greater than about 100 Kev. Possible improvements in the range of the experiments are discussed. The short-lived isomers of Ta^{181} and Re^{187} have been confirmed. The half-life of the metastable state in Re^{187} has been found to be $(5.26 \pm 0.12) \times 10^{-7}$ sec. Negative results are reported for 19 isotopes. In particular the metastable states reported by other authors in Hg^{198}, Pr^{141}, and Te^{124} are not confirmed. The half-life of ThC′ has been found to be $(3.04 \pm 0.04) \times 10^{-7}$ sec.

163 Measurement of particle energies with scintillation counters. G. F. J. Garlick, and R. A. Fatehally. Phys. Rev. 75, 1446(1949) May 1 (Letter to the editor).

It has been found that small ($1 \times 1 \times 1.5$ mm) crystals of natural, transparent scheelite used in conjunction with photomultipliers having an antimony-caesium cathode, give output pulses of fairly uniform size from α-particles of a given energy. These results are similar to those obtained by Kallmann for cadmium sulfide crystals (Phys. Rev. 75, 623(1949)). An "integrated bias" curve for pulses caused by α-particles of 4.5-Mev energy and a pulse-height distribution curve derived from it are shown. Some general results obtained for stilbene, as a napthalene crystal activator, and for several inorganic phosphors are also reported. The latter data are contrary to those obtained by Kallmann (Research 2, 62(1949)).

164 A new method of measuring curvatures and scattering angles on cloud chamber tracks. Johanna Rüling and Herma Gheri. Acta Phys. Aust. 2, 335-347(1949) (in German) (See also Nuclear Science Abstract 2-1874).

The scattering action of particles of the gas filling a Wilson chamber upon an ionizing particle produces distortions in the tracks and modifies the curvatures due to a magnetic field. The authors trace "tangent curves" through points of a graph representing the tangent slopes at different points of the track. These tangent curves show discontinuities that correspond to the more intense scatterings. By this procedure collisions with gas molecules can be revealed which deviate the studied trajectory by more than 1°. Necessary corrections in the determination of the true track curvature can then be made. The scattering angles can also be determined. It is shown that the sum of the squares of scattering angles per unit length is 5-50 times larger than that found theoretically. Five examples of the application of the method are given, with track photographs, curves, and tables.

165 The expressions for the energy and the impulse of the characteristic electromagnetic field of the electron in motion. Bernard Kwal. J. phys. radium 10, 103-104(1949) Mar. (in French).

The appearance of the factor 1/3 in the expression for the total energy of the electron in motion, results in the simultaneous use in the calculations of a tensor quantity (tensor of energy and of impulse) and of a quantity which is not a tensor (element of volume). The difficulty vanishes if the element of volume is given a tensor definition.

PHYSICS (continued)

166 Interaction hamiltonian for photon, meson, and nucleon fields. George J. Yevick. Phys. Rev. 75, 1450-51(1949) May 1 (Letter to the editor).

Using the methods developed by Tomonaga and Kanesawa (Prog. Theo. Phys. 3, 1(1948)), the Hamiltonian has been obtained for vector mesons interacting simultaneously with nucleons and with the electromagnetic field. Expressions for the interaction Hamiltonian are given for the photon-vector meson-nucleon system, as well as for the photon-scalar meson-nucleon system.

167 Quantum theory of radiation damping for discrete states. W. Heitler and S. T. Ma. Proc. Roy. Irish Acad. 52A, 109-125(1949) Feb.

The theory previously developed by Peng and Heitler (Proc. Cambridge Phil. Soc. 38, 296(1942)) in which the present form of quantum electrodynamics is used to obtain an account of radiation damping (to the extent to which it corresponds to the classical Lorentz force) is shown to correspond to a generalization of Weisskopf and Wigner's previous formulation (Z. Physik 63, 54(1930); 65, 18(1930); 85, 451(1933); Ann. Physik 9, 23(1931)). In the Peng and Heitler treatment the divergence difficulties arising from the interaction of elementary particles with high-energy photons are avoided by a systematic elimination of the infinite parts of the theory (the so-called "roundabout transitions"). In this paper the process is considered as stationary, and energy representation is used instead of time representation. The general theory previously developed is applied to cases where discrete levels are involved, by means of the necessary further considerations. It is shown that any non-stationary process can always be resolved into stationary processes by means of a Fourier transformation from time representation to energy representation. The method consists of applying the stationary method to each individual stationary process corresponding to a particular value of the energy variable. By transforming back to the time representation, the probability amplitudes of the non-stationary problem can be obtained. When applied to the present form of quantum electrodynamics, this method usually gives divergent results, due to the interaction of high energy photons with elementary particles. However, it is shown that this difficulty can be avoided by a trivial generalization of a previously used method. The theory is applied to the problem of resonance fluorescence and to the problem of propagation of light. With respect to the latter, agreement with the results of Kikuchi and Fermi (Z. Physik 66, 558(1930); Revs. Modern Phys. 4, 87(1932)) is obtained.

168 Relativistic covariance in the theory of the superquantized photon. Olivier Costa de Beauregard. Compt. rend. 228, 296-298(1949) Jan. 24 (in French).

The previous calculations of Schwinger Phys. Rev. 74, 1339(1948) are reviewed briefly and applied to the case of the free electron and photon. The integral expression thus obtained shows statistical agreement with the usual theory (Mécanique Ondulatoire du Photon et Théorie Quantique des Champs, Paris, 1949 p. 92) only in the case of an isotopic spatial distribution. It is believed that the results obtained should help to clarify the difficulties encountered in order to obtain a relativistic symmetrization of the non-superquantized quantum formalism.

169 Relativistic terms in the interaction between nucleons in pseudoscalar and vector meson theory. L. Van Hove. Phys. Rev. 75, 1519-23(1949) May 15.

The second-order interaction between nucleons in the pseudoscalar and vector meson theory is calculated, all terms being taken into account. It is shown that in both cases the exact expression for the interaction caused by virtual exchange of mesons involves contact interaction terms which cancel the well-known direct coupling terms of the Hamiltonian. The remaining interaction is essentially different from the expressions given by usual derivations. Its singularity for small separations r of the nucleons, usually obtained in r^{-3} for pseudoscalar and vector fields, is reduced for the former and not for the latter, so that no singularity can be removed by a mixture of the mentioned fields. For pseudoscalar mesons all interaction terms are proportional to some power of the nucleon velocity, whereas for vector mesons there is a non-vanishing static approximation in r^{-1}. It seems impossible from the present treatment to draw precise and reliable conclusions about the deuteron.

PHYSICS (continued)

170 Sommerfeld's polynomial method in the quantum theory. A. Rubinowicz. Proc. Koninkl. Nederland. Akad. Wetenschap. 52, 351-362(1949) Apr.

The eigenvalue problems which can be treated by Sommerfeld's polynomial method (Atombau und Spektrallinien 2, 716(1939)), in which the eigenfuction of the originally given differential equation is split into two factors, are indicated and complete treatment of the following problems is included: (1) the radial functions of the spherical symmetric case; (2) the differential equation of associated Legendre functions. In addition the polynomial method is applied in the case of (2) after a linear transformation of the independent variable; this is shown to lead to the differential equation of the Jacobi polynomials.

171 Strings, poles, and the electron. John A. Eldridge. Phys. Rev. 75, 1614-5(1949) May 15 (Letter to the editor).

Dirac's treatment of magnetic poles in terms of strings (Phys. Rev. 74, 817(1948)) is compared with Wilson's discussion of the single pole (Phys. Rev. 75, 309(1949)). Dirac considers the relation between a charge and a pair of magnetic poles; the latter are connected by a "string" so as to introduce a solenoidal field as well as an irrotational field. On the other hand, Wilson considers the relation between a charge and a single pole. Although the momentum of the system in this case is also that of the particles plus the momentum of the crossed fields, there is now no solenoidal field and hence no vector potential. It is noted that it is likely that the poles must exist in pairs. For a system consisting of a charge and a pair of opposite poles the angular momentum in the field will not have a definite value but will approach zero if the distance between the poles is made small in comparison with their distances from the charge. The result becomes definite if the poles have an infinite separation with the charge at a finite distance from their line of separation. The angular momentum of a charge and a pair of poles with finite separation has a definite magnitude in the special case that the charge and poles are colinear. The author notes that an electron could be represented by a charge and two magnetic poles, the latter separated by a distance e_0/mc^2, a value sometimes given for the electron diameter. The correct value for the magnetic moment will result; however, to obtain the correct spin it is necessary to postulate that the charge spends only half its time between the poles.

172 Decay of gross fission product γ-activity and energy after short cyclotron bombardments. N. Sugarman, S. Katcoff, N. Elliott, and J. D. Knight. AECD-2611, nd. Decl. May 17, 1949. 16p. For publication in NNES.

The gross decay curves of short-lived fission product γ-emitters were obtained at the cyclotron for short periods of irradiation (10 seconds–5 minutes) and for varying amounts of Pb absorber. The γ-activity was measured within 1 second after the end of the bombardment and followed for periods up to 2 hours. An Al absorber of 2.11 gm/cm^2 thickness was put directly in front of the sample to absorb β-radiations up to 4 Mev in energy. The initial half-life of the decay curve for short bombardments is of the order of 8s, and for 5m irradiations is of the order of 40s. Since the absorption curves reported here were measured using Pb absorbers, it was impossible to measure the energy of γ-radiations above 3 Mev because of the minimum in the energy vs absorption curve at that point; there are indications that there is a substantial amount of hard γ-radiation.

173 The radioactivity of potassium 40: a survey of investigations. B. S. Weaver. AECU-227, Nov. 29, 1948. 13p.

The present status of investigations on the radioactivity of natural potassium and of enriched K^{40} is surveyed. 42 references.

174 Beta-decay spectrum of Ag^{110}. Werner S. Emmerich and J. D. Kurbatov. Phys. Rev. 75, 1446-7(1949) May 1 (Letter to the editor).

The disintegration of Ag^{110} into the isobars Cd^{110} and Pd^{110} was studied by means of a cloud chamber since the possibility of disintegration into Pd^{110} by emission of positrons could not be excluded. The results obtained in air with a field of 372.5 gauss indicated: (a) the existence of converted electrons

PHYSICS (continued)

corresponding to the γ-rays of Ag^{110}, and (b) electrons of a continuous spectrum and the Kurie plot produced a straight line in the energy range from 150 Kev to 550 Kev with upper limit about 0.59 Mev. The upper ratio of the number of positrons, to the number of the electrons of the continuous spectrum did not exceed 0.2%. From these data it is concluded that there is no positron disintegration in Ag^{110} with branching ratio β^+/β^- higher than 0.2%. A second series of tracks were photographed in helium with a field of 149 gauss. These provided evidence for the existence of a continuous spectrum of electrons of upper energy 90 $\pm$ 10 Kev.

175 Beta-ray spectrum of K^{40}. David E. Alburger. Phys. Rev. 75, 1442-3(1949) May 1 (Letter to the editor).

The results of a lens spectrometer measurement of β-ray distribution from samples of potassium enriched 100-fold in K^{40} are reported. A curve of the β-ray intensity distribution of K^{40} as a function of momentum is shown which has a maximum at 11.8 counts/min against a background of 18.3 counts/min. The results shown compare favorably with those predicted by theory. A Fermi plot taken from the experimental points is also shown which gives an end-point energy of 1.40 $\pm$ 0.03 Mev. The fact that the Fermi plot is linear above 450 Kev is interpreted as evidence that the excess of low energy electrons is mainly due to scattering, since a similar effect was observed for the spectrum of P^{32}.

176 Characteristics of the fission product Cs^{135}. Nathan Sugarman. Phys. Rev. 75, 1473-6(1949) May 15.

The decay products of two samples of Xe^{135} of high intensity contained a Cs activity presumed to be Cs^{135}. The half-life of Cs^{135} was found to be $(2.1 \pm 0.7) \times 10^6$ yr. and the maximum energy of its β^--radiations was found to be 0.21 Mev. No γ-radiations were detected. The capture cross section of Cs^{135} for pile neutrons was determined to be 14.5 $\pm$ 4 barns.

177 The decay of Co^{55}. Martin Deutsch and Arne Hedgran. Phys. Rev. 75, 1443-4(1949) May 1.

Using the data obtained by previous investigators (Siegnahn, Svartholm, and Hedgran, (to be published); Lawson, Phys. Rev. 56, 131(1939); Siegbahn and Johanson, Arkiv Mat., Astron. Fysik 34A, No. 10(1946)), the decay scheme of Co^{55} has been formulated. The scheme shows two positron transitions from 2.42 Mev ($+2m_0c^2$) to 1.41 Mev and 0.935 Mev; these are of approximately equal intensity. In going to the ground state from these levels a 1.41-Mev γ-ray may be emitted or a 0.935-Mev γ-ray may be given off. Since decay from the 1.41-Mev level can be in two steps, i.e., to the ground state, or to 0.935 Mev, a 0.477-Mev γ can also be emitted. The only discrepancy with the data is the lack of explanation of a 0.095-Mev γ-ray the presence of which has been deduced from the internal conversion negative electron spectrum.

179 The efficiency of the internal conversion process in Br^{80}. William H. Hamill and J. A. Young. J. Chem. Phys. 17, 215(1949) Feb. (Letter to the editor).

Data have been taken preliminary to quantitative kinetic studies with Br^{80} (4.5 hours) in gaseous systems. It is first necessary to measure the conversion efficiency in terms of the chemical effects produced in a gaseous system, and to correlate quantitatively, if possible, chemically and physically measured conversion efficiencies. Tabulated data are shown. The experiments demonstrate that there is no branching decay of Br^{80} (4.5 hours), that the chemical effects produced correspond to complete conversion, in agreement with the physical effects, and that quantitative correlation of chemical effects with nuclear phenomena in the liquid phase may be unreliable.

PHYSICS (continued)

181 On the accuracy of the standard radium preparations. Berta Kremenak. Acta Phys. Aust. 2, 299-311(1949) Feb. (in German).

Actinometric measurements of the Vienna standard radium preparations showed the unsoundness of the criticisms of the reliability of these standards, which have been made by Weiss (Z. Physik 120, 652(1943)).

182 On the beta-particle spectrum from the decay of radium E. Arthur Waltner and F. T. Rogers, Jr. Phys. Rev. 75, 1445-6(1949) May 1 (Letter to the editor) (See also Nuclear Science Abstract 1-1320).

The results which the authors obtained on the β-decay spectrum of RaE using a vapor of $Bi^{210}(CH_3)_3$ in a cloud chamber are compared with the data obtained by Richardson (Proc. Roy. Soc. (London) 147A, 442(1934)), Madsen (Acta Jutlandica Aarskrift for Aarhus Universitet 15, 1(1942)), and Waltner and Rogers (Phys. Rev. 74, 699(1948)). A general agreement is indicated which leads to the following conclusions: (1) that the maximum of intensity in the observed spectrum of β-particle energies from RaE lies at a rather low energy (~30 Kev, more or less); and (2) that the intensity in this observed spectrum drops off sharply at lower energies apparently to quite small values.

183 On the decay of K^{40}. E. L. Fireman. Phys. Rev. 75, 1447(1949) May 1 (Letter to the editor).

Several consequences of the fact that K^{40} has been observed to decay by electron capture and not by positron emission are discussed. The consequences are: (1) a determination of an upper limit to the A^{40}-K^{40} mass difference, (2) the possibility of observing positrons from K^{40} if estimates of the K capture are correct, and (3) a determination of the ratio of the nuclear matrix elements for the A- and Ca-transitions.

184 On the existence of the β-branching of RaA and of the isotope 218 of radon. R. J. Walen. J. phys. radium 10, 95-103(1949) Mar. (in French) (See also Nuclear Science Abstract 2-843).

Using a proportional amplifier the active radon deposit has been studied using the method of Karlik and Bernert (Naturwissenschaften 31, 298(1943); Z. Physik 123, 51(1944)). In addition to an α-emitter derived from RaA, which has been identified as At^{218}, a second α-emitter has been identified which is a product of the former. The new emitter has been identified as Rn^{218} (1.3 sec half-life) which constitutes 10^{-12} of the number of atoms in normal radon. Diagrams of the apparatus used and decay curves and schemes are given. 12 figures.

185 On the maximum β-energy release in tritium. L. Slack, G. E. Owen, and H. Primakoff. Phys. Rev. 75, 1448(1949) May 1 (Letter to the editor).

It is noted that recently published data by Jenks, et al (Phys. Rev. 75, 701(1949)) on the calorimetric determination of the average β-energy release in H^3, 5.69 ± 0.06 Kev, enables an equally accurate determination of the maximum β-energy release. The latter is found to be 18.6 ± 0.2 Kev which is in excellent agreement with the value of 18.5 Kev obtained by Pontecorvo (unpublished) which has been quoted by Seaborg (Revs. Modern Phys. 20, 585(1948)). This value establishes the consistency of recent measurements on the two simplest β-active nuclei, H^3 and He^6 with the Gamow-Teller selection rules.

PHYSICS (continued)

186 On the numerical calculation of the internal conversion in the K-shell. The electric dipole case. J. P. Stanley. Can. J. Research 27, 17-25(1949) Mar.

Hulme's formula for the internal conversion of γ-radiation is simplified and used to calculate the internal conversion coefficient in the electric dipole case for electrons in the K-shell. For each of the elements Z = 69, 74, 79, 84, 89, I_k (the K-shell conversion coefficient) is calculated for 10 values of the variable $\theta = \frac{mc^2}{h\nu}$ and a table obtained by interpolation is given for $\theta = 0.05$ to $\theta = 1.70$.

187 On the theoretical calculation of the variation of the half-life of Be^7 as a function of the degree of ionization of the atom. Pierrette Benoist. Compt. rend. 228, 309-310 (1949) Jan. 24 (in French).

The possibility, which has been advanced previously [Bouchez et al J. phys. radium 11, 337(1947); Compt. rend. 227, 525(1948)], that the period of decay of Be^7 by the capture of orbital electrons may be influenced by chemical ionization has been investigated theoretically. The following approximate expression is given for the fractional change in half-life: $\frac{\tau' - \tau}{\tau} = \frac{R_k^2(O) + R_{L_I}^2(O) - R'^2_k(O)}{R'^2_k(O)}$, in which $R_k^2(O)$, $R_{L_I}^2(O)$ and $R'^2_k(O)$ are proportional to the probabilities of the presence of a K and an L_I electron in a neutral Be^7 atom and of a K electron in a Be^{++} ion, respectively. Tabulated values of the probabilities and of the percentage change in half-life are given which were calculated using values obtained by Slater [Phys. Rev. 36, 57(1930)] and by Hartree [Proc. Roy. Soc. (London) 149, 210(1935); 150, 9(1935)]. A percentage change of 2.7 is obtained for the latter if exchange interactions are neglected, whereas this becomes 2.6% if the exchange interaction is taken into account. Using Slater's data, the calculated change in half-life is only 1.8%. The discrepancy between the results obtained for the two theories is discussed.

188 Precision measurements of gamma-rays from I^{131} with the 2-meter focusing curve crystal spectrometer. David A. Lind, James Brown, David Klein, David Muller, and Jesse DuMond. Phys. Rev. 75, 1544-5(1949) May 15.

Using a 2-meter curve crystal focusing spectrometer three nuclear γ-ray lines from I^{131} have been found to have wavelengths $(34.033 \pm 0.01) \times 10^{-11}$ cm, $(154.671 \pm 0.01) \times 10^{-11}$ cm, $(43.622 \pm 0.02) \times 10^{-11}$ am which correspond to energies of 364.18 ± 0.1, 80.133 ± 0.005, 284.13 ± 0.1 Kev. The sum of the last two energies equals the first to an accuracy of a part in 4500, thus verifying a decay scheme proposed by Metzger and Deutsch [Phys. Rev. 74, 1640(1948)] in which the 80- and 284-Kev lines form a cascade between the same pair of excited levels of Xe^{131} as the initial and final levels for the 364-Kev line. An alternative proposal seems also thus to be invalidated. The intensities of the lines are discussed, and a method of calibrating the efficiency of the multicellular Geiger counter as a function of wavelength, depending on the use of such cascades, is proposed. This is probably the first time that a precision test of the Ritz combination principle as applied to nuclear γ-rays has been possible. It also furnishes an excellent internal check of the reliability of the wavelength scale of the 2-meter curved crystal spectrometer.

189 Radiations from Ge^{77} and Ge^{71}. C. E. Mandeville, Y. H. Woo, M. V. Scherb, W. B. Keighton, and E. Shapiro. Phys. Rev. 75, 1528-31(1949) May 15.

Twelve-hour Ge^{77} was found to emit β-rays of energy 1.74 Mev and γ-rays of 0.5 Mev and β-γ-coincidences were measured in the 12-hour period. Experiments indicate that the 40-hour positron emitter is not formed by slow neutrons on germanium. The 11-day Ge^{71} decays with the emission of the x-rays of gallium following orbital electron capture. Previously obtained absorption curves have given evidence of emission of charged particles by the 11-day period. This misinterpretation is discussed. The chemical procedure for the separation of germanium and arsenic and the purification of the former are included in an appendix.

PHYSICS (continued)

190 Radioactive silver isotopes produced by photo-disintegration of cadmium. R. B. Duffield and J. D. Knight. Phys. Rev. 75, 1613(1949) May 15 (Letter to the editor).

Evidence of two hitherto unassigned silver activities of half-lives 5.3 hr and 20 min, which have been attributed to Ag^{114} and Ag^{115}, has been found in the silver fraction isolated from cadmium which had been irradiated with 21-Mev betatron x-rays. Decay curves and curves of relative yields (compared with those of the 3.2 hr Ag^{112} and the 7.6-day Ag^{111} produced by (γ,p) reactions in the same irradiation) which were obtained from counting data are shown. The two new activities are associated with β-emission and from the aluminum absorption curves for the two activities the β-ray energies were found to 2.1 ± 0.2 Mev and 3 Mev for the 5.3 hr activity and the 20-min activity, respectively. No γ-radiation was detected in either case. In addition, irradiation of the Cd^{14} sample with fast neutrons from 10-Mev deuterons on beryllium produced a 2-min, β-emitter which is probably that of Ag^{114} produced by $Cd^{114}(n,p)$.

191 Standardization of radioactive iodine. Sergei Feitelberg. Science 109, 456-61 (1949) May 6.

The techniques and instrumentation of standardization which are available in most laboratories which are equipped for work with radioactive isotopes in biology and medicine are described with particular reference to the standardization of radioactive iodine, I^{131}. Some of the general problems of standardization and the criteria which are applied in choosing a suitable system of units for a particular standardization are discussed. Since the results obtained in standardizations performed in 70 different laboratories on samples of equal I^{131} content are shown to have a standard deviation of 30 per cent, the values ranging from 43 to 180 mrd/ml, the necessity for more accurate standardization methods is indicated. Three principal method-types were used to obtain the aforementioned standardizations: (1) primary measurements; (2) comparison with a standardization sample of a long-lived radioactive isotope; and (3) calibration with a previously standardized (by methods 1 or 2) I^{131} sample. Some improvements possible in the different standardization categories mentioned are suggested; one of these stressed is the replacement of the G-M tube by an ionization chamber for standardization work.